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THE PRESS AND ELECTRO-MEDICAL REMEDIES.

A COMPETENT writer on the development of advertising once remarked that "it is, of course, only natural that the portion of the community which regards the other portion as its oyster was not slow to discover the advantages which were soon to accrue in the way of increased facilities for publishing new dodges, or of giving extended scope to those which were old, but had so far attained only limited circulation."

Discoverers of a single remedy for numerous complaints have in all times striven to make its virtues widely known, and have generally been able to obtain some believers. Alchemists who failed to find the philosopher's stone usually succeeded in discovering an "Elixir of Life." Later wonder-workers slightly alter the formula, and more widely proclaim that "Electricity is Life." The healing art is mystery to the multitude, and the electric art is mystery, too, so that the electro-medical is mystery on mystery. Yet this complex remedy is simplicity itself to its exponents and the public.

It was "a citizen of the world" who said that "the professors of other arts confess the inevitable intricacy of things, talk with doubt, and decide with hesitation: but doubting is entirely unknown in medicine; the advertising professors delight in cases of difficulty; be the disorder never so desperate or radical, you will find numbers in every street who, by levelling a pill at the part affected, promise a certain cure."

Whilst true of medicine, it is truer still of electro-medicine, which, in its combination of mysteries, has always appealed to public cupidity. The advance of years, and the spread of education, make no difference. Towards the end of the last century, such a charlatan as "Katerfelto" pressed electrical experiments into service to mystify his clients, and, living in pre-Wimshurst days, obtained his electric sparks from six black cats, termed "the doctor's devils." He is said to have mixed up with his quackery some real science, and announced himself as the friend and correspondent of Dr. Franklin. At an even earlier date (1779) the notorious Dr. Graham opened his "Temple of Health" in the Adelphi, and largely advertised "the Celestial brilliancy of the medico-electrical apparatus in all the apartments of the temple." In 1798 Benjamin Douglas Perkins invented and took out a patent for "Metallic Tractors"—two small pieces of magnetised metal, which were said to cure almost every disease if applied externally to the affected part. His success was phenomenal, though, for the credit of those times, it was a medical practitioner who succeeded in showing the real curative value of the magnetic appliance by successfully treating several cases with wooden "Tractors" painted to resemble the metal. Still earlier magnetic treatment for hernia had the merit of being based on a principle—"Kircher the Jesuit" advised his patient to swallow a magnet reduced

to powder, and had a poultice of iron filings applied to the external swelling, expecting that the attractive power of the magnet when it reached the corresponding place inside would draw in the iron and so restore the organic defect. The result history recordeth not, but it is probable that the patient no longer felt his pains.

We are concerned now to ask what should be the attitude of the general Press at the end of the nineteenth century towards such wonder-workers as these, should any such seek to make known his remedies through their columns. Those we have cited advertised largely, and we know that at this date the importance of advertisements to the Press is even greater than a century ago. It is sometimes forgotten that the power of the Press is largely due to the advertisers who furnish the means. Quite recently a baronet-editor, presiding at a banquet, expressed to a firm of soap makers the obligations which the Press were under to those who had initiated a system of extensive publicity. Amongst the most prolific advertisers in general newspapers are the vendors of soaps and medicines. It needs but slight effort for a newspaper proprietor to assure himself that he is conferring a positive benefit on humanity by extolling the virtues of soap, and he may reasonably conclude that he is doing no direct harm, and possibly doing some good, by setting forth in bold type the advantages of pills. In such matters the public is well able to take care of itself. It has a ready method of judging the efficacy of pills, and if they should happen to be prepared in accordance with the recipe of an out-of-date pharmacopœia, they are likely to be more highly esteemed. The public is quite able to judge one soap against another, and a general newspaper therefore does no harm in giving space to a soapmaker to describe his own manufactures as the best in the world, any more than we do by permitting a manufacturer of switches to describe his productions in the same way. Our respective readers are perfectly capable of judging for themselves.

Only a Don Quixote tilts against a windmill, and none will be found at this date to limit the freedom of the public in its choice of remedies. But has the Press no duty in the matter? Supposing that it becomes notorious that the Press is being made the instrument to open the oyster and that the pearls which it receives as the price of its publicity are extracted from the oyster with much suffering, has it no alternative but to go on receiving those pearls? We grant the question is difficult. In the absence of legislation to the contrary, the newspaper proprietor is legally justified in advertising anything which is paid for, and leaving his readers to judge for themselves. For some classes of advertisements legislation has been invoked, but responsible newspapers have voluntarily excluded such advertisements before they were required to do so by law—an indication that reliance on the high character of the Press is not misplaced. It cannot well discriminate until an evil becomes flagrant, and it may often remain in ignorance of the evil long after it is apparent to others. But, apart from any such discrimination, which is unquestionably difficult, there is another remedy, for, as in Nature some antidotes are placed in the near neighbourhood of poisons, so in the Press is there a proper corrective for evils, provided the absolute distinctness of its news columns and its advertisement columns is maintained as the public understand them to be maintained. A company prospectus and a money article notice is a case in point. The one is a paid invitation to the public to subscribe, and the other is often a distinct editorial advice to the contrary. The one could not be excluded, but its corrective could be inserted. It is not to be forgotten that the power of the Press is twofold. There is the power of expression and the power of suppression. The exercise of the latter may be productive of greater evils than the good which is obtained by the former. The publication of law reports is governed by the views of the conductors of a journal as to what will be of interest to, rather than to the advantage of, their readers. It is certain that interested parties are not able to judge as to the inclusion or exclusion of cases, much less as to the abbreviation of reports, otherwise we should be disposed to say that the publication accorded by the general Press to a recent case was insufficient to enlighten the public on points of greatest interest to them, and not a sufficient antidote to the publicity accorded to the evil in outer columns. Whilst thus referring generally, we cannot refrain from mentioning that there were notable exceptions, and we believe we are correct in saying that advertisements of the nature to which we refer have for some time been excluded from the columns of "the leading journal."

We appeal to the general Press to consider its position in this matter. It would be with considerable reluctance that we should come to a conclusion that it would not take the proper course when the nature of an evil is within its ken. The Press has traditions, and those traditions should be maintained. We can point with pride to the unanimity of the electrical Press in their efforts to prevent the public being misled by the misuse of the science to which they are devoted. We can include also the medical Press, but the efforts of both are comparatively futile unless the general Press does its duty too. The Press should see to it that suffering and sorrow are not propagated by its means.

THE MIDLAND RAILWAY AND ELECTRIC LIGHTING.

Some few months since the Midland Railway Board, purely in the interest of their staff at Derby, determined to introduce the electric light into all the offices in which night or late evening work had to be conducted. The result of this, together with the lighting of a range of new offices for the engineer of the line, and others for the general manager's department, was the installation of some 2,000 16-C.P. lamps. The work appears to have been pressed forward with commendable energy on the part of all concerned, for, although the lighting has involved an enormous amount of work, owing to the extended area over which the lighting has had to be established, fully one-half the lights are already in operation, and the remainder will, we understand, be in circuit within a week, with the exception of those required for the new Literary Institute—a fine building rapidly approaching completion—erected by the company for the comfort and improvement of their *employés*.

Those who know the Derby railway station will be aware that it is a long straggling station, with the station offices extending the entire length of the platforms. There are also

large blocks of offices for the accountant's department, also the goods, minerals, and architect's departments, all scattered around at distances varying from one hundred yards to a quarter of a mile. On account of this scattered arrangement of the buildings to be lighted, it was found necessary to establish the generating station at another point, off the station, therefore, it will be seen that the provision required has been really that of a small supply station. Such has evidently been in the mind of the company's engineer, for provision has been made, not only in the generating station and buildings, but in the cable arrangements, for a large addition to the lighting at no distant date. The advantages of the light having once been ascertained by the offices in which it has been provided, there is little probability of the others remaining out in the cold. We do not for a moment think it will be long before Mr. Langdon will be called upon to make the lighting universal throughout the whole of the offices.

We hope, shortly, to be able to give fuller details of the work. In the meanwhile we may say that the generating station is quite a model station. An excellent building provides for engine room, boiler house, store room, and workshop. In the engine room there stands a small Willans and Robinson engine, with a Siemens shunt dynamo, capable of delivering 275 ampères at 120 volts, intended for light loads, with a larger one on either side, capable of distributing 500 ampères each at the same voltage. The distribution is on the three-wire system. A very fine switchboard occupies the centre portion of one side of the room. On it are arranged five of Lord Kelvin's ampèremeters, and five switches, with the usual provisions for safety fuses on mains and feeders. The entire board with all its fittings, except the meters, as also the numerous distribution boards, have been turned out by the company's own electrical shops. The switches are a novelty. Inasmuch as during the day and at certain hours during the night the load is a light one, it has been arranged that the small engine alone shall carry it, the two larger engines taking the heavy load, or all three being used, if need be; thus during the light load time the three wires are converted into a two-wire system. The switches are so arrranged that there shall be no chance of reversal of polarity in the field magnets, and, barring gross negligence on the part of the attendant, no chance of a muddle in changing over from the one to the other system, or putting the machines in circuit; the switches lock and, when once locked, are immovable till released; they were designed by Mr. J. Sayers, and their action is, we understand, highly satisfactory. We hope, at no distant date, to be able to produce a representation of the board with its equipment.

Space is reserved for two more 500 ampère machines and engines. The boilers are locomotive boilers working at 140 lbs. pressure. The arrangement of the building is such that should it be found desirable at a future date to call for arc lighting on the station, or in the company's goods depôt at St. Mary's, or their large marshalling sidings, the boiler-house can be extended, and an additional building attached for the arc lighting machinery.

We should be glad to see other railway companies fostering electric lighting as the Midland are. We very heartily congratulate the Midland board on their discrimination, and we consider that whatever may have been the outlay thus incurred in the interest of their staff, they will be amply repaid by the greater energy and freedom from sickness which their employment in a purer atmosphere is certain to produce. As regards the staff, we believe the company has probably, by its consideration for their welfare, added some years to their lives.

ECONOMY IN USING INCANDESCENT LAMPS.

In the *Electrical World* for February 4th, Dr. L. K. Böhm has an article purporting to demonstrate, by means of figures, the results in money obtained by running lamps from central stations at different degrees of incandescence. He deals with ground frequently travelled over by others and comes to the same general conclusion as his predecessors, but it must be conceded that the facts (at least some of them) are stated in a clear and precise manner. Amongst earlier records in this direction we may mention a paper read before the American Institute of Electrical Engineers on April 10th, 1888, by Mr. John W. Howell, an abstract of which we gave in our issue of June 29th, 1888. The conclusion arrived at is, that after deducting the cost for lamps, the gain to the supply company is appreciable even when running the lamps at as high an efficiency as 2·5 watts per candle. Thus with 16 C.P. lamps at 50 cents each and a charge of 1 cent per lamp-hour for current, the receipts per E.H.P. for 600 hours work out at :—$67.28 at 4 watts per candle-power, $82.50 at 3·1 watts, and $93.25 at 2·5 watts. This is when putting the average life of lamps running at 2·5 watts at 300 hours (which, in our opinion, is too long, especially for those of small candle-power and high E.M.F.), those at 3·1 watts at 600 hours, and those at an efficiency of 4 watts at 1,500 hours. In America it is usual with many central stations to supply customers with lamps and current at a fixed charge, instead of charging for the amount of current consumed, as is the practice in England; so that any benefit that is derived by running at high incandescence is received by the company and not the public. But the economy obtained by bright running, as illustrated by the above figures, is certainly too high, for neither Dr. Böhm, nor several others who have written on this subject, take into account the fact that although a lamp may start at 2·5 watts per candle-power, the efficiency soon runs down most deplorably, and at a much greater rate than those starting at a lower efficiency. Given lamps that do not alter appreciably on running at 2·5 watts per C.P. and that last an average of 300 hours, and we have nothing to say against the deductions arrived at by Dr. Böhm; but although we are aware that the average illuminating power often varies with the make of the lamp, we have come across none that are exempt from serious diminution of illuminating power on running at such an efficiency. It thus happens that calculations based on an ideal efficiency are exaggerated, if not, in some cases, rendered fallacious. Dr. Böhm's point is that central stations which supply customers with lamps of, say, 16 C.P. at a high efficiency, pay better than those supplying lamps of the same candle-

power at a lower incandescence, and we do not contend that on this point he is not correct; but we maintain that companies adopting the policy of bright running flourish to a large extent at the expense of the public by nominally supplying lamps of 16 C.P., whereas after a comparatively short run, the latter give anything but their initial candle-power, and thus the public became the losers. By forcing lamps less at the start, as already stated, the diminution in illuminating power proceeds at a slower rate, so that it is to the advantage of the public to be supplied with lamps of comparatively low incandescence, while to the companies the reverse is the case. These remarks apply to America rather than England, on account of the different systems of making charges for electric light, but whether in America, or elsewhere, the underlying economic principle remains unaltered. The question of blackening and general change in lamps on running is a very important one, and in dealing impartially with questions of economy in using incandescent lamps, should never be omitted.

Water-power Utilisation.

Under this title our contemporary, *Electricity*, commenced a few weeks ago a series of articles from the pen of our frequent contributor, Mr. W. H. Booth. It would be foolish to attempt any criticism at so early a stage in the publication of this series. Readers of the Electrical Review will remember that an exhaustive series of papers on water-power as used for electrical work was recently contributed by Mr. E. Tremlett Carter. The present series does not appear to attempt so complete a discussion of the subject, and deals with it in a simple and non-mathematical, yet practical fashion. One of the turbines described is a form which does very good work, but which is not well known in this country; it is called the Cheetham turbine. Possibly a recent correspondent of ours, who could not get the high efficiencies claimed for turbines, had been experimenting with an engine having this invidious name. Yet it is an excellent turbine, especially on high falls, in which respect it resembles the Pelton wheel. We shall have occasion at a later date to refer to this series of papers.

Thermo-electrics.

Dr. Carl Barus, whose researches on what may be termed experimental geology have been attracting a good deal of attention during the past few years, appears to have pronounced very strongly in favour of the thermo-electric method of measuring high temperatures. We are glad to notice this approval from an authority of such high standing as Dr. Barus. The subject of pyrometry is a very difficult one to investigate, and physicists have been accustomed to disregard it; there is more activity shown amongst them now, and this is doubtless due to a demand, which must not be overlooked, by manufacturers who recognise the importance of been able to ascertain with accuracy the temperatures at which their processes are in many cases conducted. Dr. Barus considers that a junction of platinum with an alloy of platinum and irridium or rhodium, gives the best results, and this opinion is the outcome of several years of difficult experimenting. In an investigation of the fusion constants of igneous rocks, parts ii. and iii. of which appear in the current issue of the *Philosophical Magazine*, he appears to have made free use of the thermo-electric method of measuring high temperatures. Indeed, it seems that without this method it would have been impossible to have achieved results of any value in this arduous study. It is to be hoped that the success which he has won will encourage a closer examination of the properties of various bodies, especially of the metals at high temperatures. Commercial advantage is certain to follow from a fuller knowledge.

High Resistances and the D'Arsonval Galvanometer.

In a short paper by Mr. F. J. Smith, which appears in the current number of the *Philosophical Magazine*, attention is called to the fact that when the d'Arsonval galvanometer is used for determining current by the fall of potential method, a large resistance is required in the galvanometer circuit; this is usually made of wire, and is rather expensive. He describes a cheap method of making high resistances with dry plaster of Paris, electrotype plumbago, and powdered glass, mixed in certain proportions and contained in sealed glass tubes. Alluding to the variation or affectation of the dead-beat action of the d'Arsonval galvanometer when the resistance of the galvanometer circuit is high, he states that the difficulty may be remedied by means of a few turns of fine covered copper wire, wound on the outside of the rectangular coil of the instrument, so as to form a closed circuit. When thus treated, the instrument gives the same reading as before for a given potential difference, and is perfectly dead-beat in its action, so that with the addition of this "damping coil," as it may be termed, any amount of resistance may be used in the circuit of the galvanometer.

"Potential," a Bernoullian Term.

Potential as the name of a function was undoubtedly introduced by Gauss in 1840 (*vide* "Gauss's Collected Works," Vol. v., 1867, p. 200); but he was certainly not the first to employ the corresponding adjective in a similar sense. George Green employed the term "potential function" in 1828 in his famous paper on electricity and magnetism (reprinted in "Crelle's Journal," Vol. xxxix., p. 77, 1850, and in his collected papers). Nowhere, however, in this paper can be found the word "potential" used as a noun, whilst as an adjective it is met with on almost every page. Most physicists give Gauss full credit for independent investigation of the potential, but Todhunter (*Math. Hist. Theories*, &c., Vol. ii., 1873, p. 26), refers to the matter in a manner which would seem to convey an innuendo. The term is of older origin than would appear from these references. In a paper signed by Geo. F. Becker in the *American Journal of Science* (February, 1893), the writer points out that Daniel Bernoulli and Euler both employed the term *vis potentialis*. Hence, Todhunter's innuendo is perhaps deserved, for although Gauss never displayed any tendency to plagiarism, it cannot be assumed that he was ignorant of Euler's famous memoir, *De Methodis*, &c. In all probability the account of Bernoulli's *vis potentialis* suggested to him the name "potential" for a somewhat similar but more general function. Becker endeavours to show in his paper that it is probably impossible that such men as Bernoulli and Euler could have had an idea of the *vis potentialis*, differing at all essentially from that which the words convey to modern ears. The history of such an important term must be full of suggestion, and seems to indicate an opportunity for a well-read physicist to write a most interesting essay on the evolution of "the potential" up to the date of Lagrange's memoir on the movement of a number of mutually attracting bodies (1,777), in which the word seems to have been used for the first time in an entirely general form.

THE SPECIFICATION OF ELECTRIC PLANT AND MAINS FOR OPEN COMPETITION.

BY THOMAS TOMLINSON, B.E., Assoc.M.Inst.C.E.

(*Continued from page* 259.)

THERE is a modification of the form of specification discussed the week before last, which is worth noticing; it is that which omits the capacity of the plant, while otherwise of the same general form.

This is the specification of the committee of a town which has got an order; but the members are very doubtful indeed whether to exercise these powers or not.

The modification is not open to the same objections as were urged against its original form, since by its very vagueness it does allow scope for advice; but, as the contractor's main object is to get the contract, and not to give advice, it is not hard to see that the value of the advice is seriously discounted.

It should be understood that, when writing here and elsewhere of the advice given by contractors, I do not mean actual advice given in so many words, but the implied advice that a committee thinks it is gaining in the tenders received in response to an indeterminate or "fishing" specification, and what I seek to establish is that the practical conditions of competitive tendering make it extremely improbable that the contractor will venture to tender on the basis of what he believes to be best; and, further, that if he does, he is not likely to get the contract.

What the framers of such a specification are likely, in their state of doubt, to accept, is the cheapest scheme which will save their order, and the tenders will therefore probably be, for the most part, for plant and mains of the smallest reasonable capacity.

Now, in commencing with a small scheme it is imperative, in order to ensure future economy, that extension be foreseen and provided for; but to make this provision would entail an extra expenditure above that necessary for the complete and perfect working of the initial scheme. The contractors will, however, be compelled to sacrifice (or, at any rate, much curtail), those provisions for future economy which they know should be made, because each will fear that the others will not make them, and so will gain a very considerable advantage through the resulting lowness of first cost.

The special form we are now discussing is open to yet another objection; the tenders sent in will have no common basis of capacity upon which they can be judged. An expert will therefore almost certainly have to be called in to adjudicate, and I submit that his services would have been of much more value before the issue of the specification, and would not have cost much more.

In connection with this calling in of an electrical engineer when it is too late for him to render effective service, it is not out of place to say that, in my opinion, the proper time to seek his assistance is before obtaining the order. You can quite easily make an order absolutely commercially valueless, if you know little enough when you are framing it.

Examples of the next form of specification to be considered vary very widely in their degrees of excellence or the reverse; but they all have this characteristic, that the specification asks for a single inclusive tender for steam plant, electrical plant, mains, and sometimes even buildings.

The effect of this characteristic varies as the specification to which it applies is otherwise good or bad in form. If good, it impairs its value; if bad, it improves it.

The object of a specification is to get the best possible value for the money to be expended. Now the best way to attain this end cannot be by making a firm of electrical engineers contractors, and making engine builders boiler makers, cable makers and builders sub-contractors; if only because it involves the payment of an extra percentage on all sub-contracted work over what it would cost to deal direct with the sub-contractors, after open competition; unless it can be shown that the extra cost of design and supervision more than balances the extra cost involved in sub-contracting. This cannot, I am sure, be shown for an installation of any but the very smallest dimensions, and for all others the sole advantage of an inclusive tender being accepted, where the specification was otherwise of the first class, is that it limits the responsibility for the completeness and efficient working of the whole to one responsible firm.

So that I contend that for an experienced engineer the form is useless, inasmuch as its sole advantage is to provide a guarantee for completeness and efficiency, which he can quite easily otherwise ensure; and it is also a bad form (unless possibly for very small installations), inasmuch as it does not ensure the best value for the money expended.

And I submit that no experienced electrical engineer should use this form if sufficiently well paid for his services to be able to afford to draw up his specification in a form better calculated to ensure the best results for his clients.

To draw up such a specification as this latter in the first place, and afterwards to interpret, adjudicate upon, and negotiate the various contracts, to work out the connecting links between the main contracts, and to form the lot into a homogeneous, efficient, and smooth working whole, will obviously demand more time, care and knowledge, than if the specification be drawn up with a view to the acceptance of an inclusive contract, and should be therefore paid for at a higher rate.

In the former case the clients pay more for advice and less for plant; they rely upon the experience and knowledge of their engineer for the result, and they get better value for their money, provided the engineer is thoroughly experienced and reliable.

In the latter case they pay less for advice and more for plant; they rely in a certain degree upon the judgment and knowledge of their engineer; but more upon the name and reputation of the contractors. They will not get such good value (under the same conditions) as they would in the former case; but they will, with any sort of reasonable care, get fair value.

But while the inclusive form is certainly not the cheapest, it cannot be denied that it has advantages, and that it is certainly a safer form for an engineer, however able, not thoroughly experienced in the commercial side of electrical engineering, if he would ensure the keeping of his "extras" within reasonable limits.

If this inclusive form be adopted, it is well to specify simply the results to be attained, so as to make the responsibility of the contractors as wide as possible; and to provide for the station being run by them for such a term, not less than six months, as may allow ample opportunity for the discovery of any omission or defects.

Under no circumstances, in my opinion, should the buildings or foundations be included.

The chance of a contractor getting any particular contract is, in general, too remote to allow of a closer estimate than can be got by cubing out from a rough sketch, or from approximate quantities, and the contractor must cover himself by a very liberal margin for contingencies.

So that you have thrown into the total, as a disturbing element, not merely the actual cost of the building, but the supposed cost, together with a large margin for contingencies.

Now, the plant and mains are the active elements of the scheme, on which its success depends, while the building is purely passive (though its arrangement is not), and there should be no possibility of such a contingency as that the tender offering the best value in plant and mains should be rejected because the contractor had estimated his building too high, or, rather, higher than his opponents.

In certain cases, as in deciding between direct and rope or belt driving, the cost of the building must be taken into account; but if the specification be so wide as to allow of tenders on both systems, it is better for the engineer to make the necessary allowances himself by cubing out of rough quantities.

A very considerable improvement is made in the form of specification now under notice by sub-dividing the tenders under various headings—as it facilitates comparison in detail—which gives a good deal more information than comparison in gross.

(To be continued.)

PRIMARY BATTERIES.

It may safely be asserted that nothing connected with the production or use of electricity has assumed so many forms or undergone so many modifications in its details as the primary battery. Ever since Galvani produced his first famous "pile," inventors have not ceased to bring out new ones, or modifications of existing ones, which may, or may not, have been improvements.

Immediately upon the introduction of the electric telegraph, followed by its rapid development as a means of communication, and the use of electricity in railway working, a great demand arose for a really efficient cell, which could be maintained at a moderate cost.

The field was large and the subject attractive. Much ingenuity was brought to bear upon the matter, dozens upon dozens of different forms of cells were introduced, of which a few were good, more were middling, and the greater number were bad. The chief difficulty appeared to be in producing a cell that did not, like those in which free acid was an ingredient (and they were in the majority) contain the germ of their own destruction, or which did not, to use an unscientific, but familiar expression, "eat their own heads off" when not actually at work. Of the numerous batteries invented up to about 25 years ago, no particular one seemed to assert its superiority; several patterns were used, yet nearly all of them were open to the same objections, especially as to the difficulty and cost of maintenance, but not one of them established its claim as the best, and obtained the proud position of the fittest that had survived.

Fig. 1.

In the year 1866, however, all this was changed by the invention of Leclanché, whose chloride of ammonium cell created quite a revolution, and, so to speak, at once took the electrical world by storm. Its simplicity and cheapness, its chemical inaction when not actually in circuit, its consequent facility and economy of maintenance, and its good electrical results were all so apparent that it immediately secured the first place and became the most generally used of all batteries. And it is most remarkable that though this cell has been for more than 25 years in use, and has run out two patent lives, it is still considered the best for general purposes, and its fame has not been diminished by any subsequent invention.

The first form of Leclanché's cell was the well known and still sometimes used porous pot pattern. This was followed by the improved agglomerate block type, of which large numbers are still made, and this in its turn has been superseded by the pattern known as the cylindrical agglomerate. This cell, patented in the joint names of Leclanché-Barbier in 1886, has for some mysterious reason never, until very recently, been commercially introduced into this country. Its success on the Continent of Europe has been great, thousands of the cells being in constant use, and the daily output of them from Messrs. Leclanché's works in Paris is now very large and rapidly increasing.

In view of these facts it may be of interest to our readers to have a description of this latest evolution of the Leclanché cell, more especially as they can now be obtained in this country, Messrs. Leclanché having lately appointed Mr. R. Aylmer, of London, as their sole agent in Great Britain and the Colonies.

The Leclanché-Barbier cylindrical agglomerate wet cell is shown in elevation in fig. 1, and in section in fig. 2.

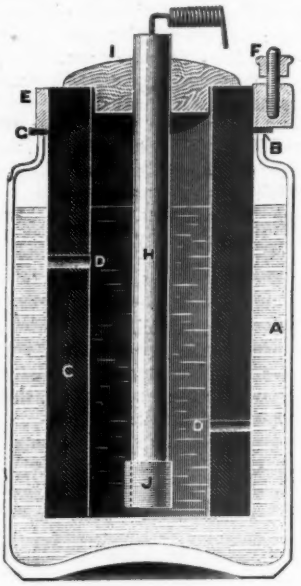


Fig. 2.

Its positive electrode consists of a hollow cylindrical agglomerate, C, composed of binoxide of manganese, carbon and graphite, round the top edge of which is cast a lead collar, E, carrying a binding screw, F. The negative electrode is an amalgamated zinc rod, H, which fits tightly in the wood stopper, I, which closes the upper end of the cylinder; the zinc is thus suspended in the centre of the agglomerate, and all chances of accidental contact between them is obviated by an India-rubber guard ring, J, on the lower end of the zinc rod. The two electrodes thus put together are placed in a glass jar, A, whose upper edge, B, is ground true, so that when the agglomerate is in its right place, the lead collar rests on the edge of the neck of the jar, and the combined electrodes are suspended in the centre of the jar without touching the bottom. An India-rubber washer, G, round the agglomerate, interposes between the under side of the lead collar and the edge of the jar, effectually closing the joint. It will be seen that by this arrangement the cell, though in reality an open one with all its parts immediately accessible, is practically a sealed one, from which no evaporation of the ammoniacal solution can take place and in which no creeping salts are developed.

The agglomerate is made by a patent process which ensures great porosity, and, therefore, more or less complete reduction of the manganese, and the presence of plumbago in it greatly decreases the internal resistance. The zinc is held in the centre of the agglomerate, and is stated to be uniformly used up over its whole surface. These cells are also stated to be most remarkable for their durability and cleanliness, and to last for years without any practical diminution in the level of the liquid and without the formation of any creeping salts, so troublesome in all the older forms of the Leclanché battery. Their electromotive force is 1·5 volts; the internal resistance of the No. 1 or larger pattern is 0·4, and of the No. 2 or smaller 0·8 ohms.

If put on closed circuit through an external resistance of 10 ohms, this cell is said to give a most satisfactory discharge curve; starting at 140 milliampères, and falling in 24 hours to 115, and then giving an almost straight line of fall for 16

days before reaching 70 milliampères, or just half its original ampèrage.

The Leclanché-Barbier cylindrical agglomerate dry cell, fig. 3, is a modification of the wet one. The outer or containing vessel is of sheet zinc, which thus forms the negative electrode and carries a copper strip for the connection. Into this is cemented a hollow cylindrical agglomerate, the same as that used in the wet cell just described, and it is the cement or fixing matter which holds the ammoniacal solution necessary for the working of the element.

FIG. 3.

It will be seen that this cell is not strictly a dry one, and in truth, no such thing as a really dry cell exists, for were it dry it would not work. All other forms of so-called dry cells, with of course more or less moisture in them, are hermetically sealed up to prevent evaporation, and when their very small quantity of solution is exhausted the cell is of no further use to its owner.

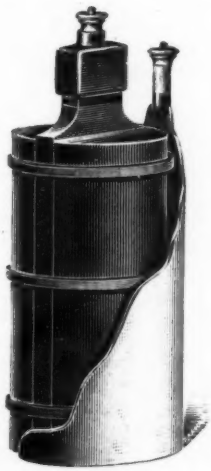


FIG. 4.

The Leclanché-Barbier does not pretend to be a really dry cell nor is it even sealed up, but, on the contrary, if the electromotive force should fall from want of solution in the cell it is only necessary to remove the loose wooden stopper that closes the cylinder, pour in some ammoniacal solution and let it stand for 24 hours and then pour off any excess of liquid not absorbed. The owner, being thus enabled to refresh the cell when necessary, can maintain it with but little trouble and at small cost.

Two sizes of this cell are made, with an electromotive force of 1·5 volts and an internal resistance of 0·5 and 0·6 ohm respectively. The discharge curve of this element working continuously through a resistance of 10 ohms is said to very much resemble that of the wet type; commencing at 140 milli-ampères and falling in the first 24 hours to 105, after which the fall is almost uniform for 16 days before it reaches 70 milli-ampères or half the original current.

The most recent modification of these cells is the Aylmer-Leclanché low resistance battery, which has been specially designed for use in those cases where a low resistance and a large amount of active matter is preferred. It consists (see fig. 4), of a large central carbon collecting plate carrying the positive binding screw. To each side of this plate is firmly held, by three strong India-rubber bands, a semi-circular agglomerate block composed of the same porous material as is used in the Leclanché-Barbier cylindrical agglomerates. The whole is surrounded by the zinc, which is in the form of an amalgamated plate, completely encircling the agglomerates. The large surface of the agglomerate blocks held in intimate contact with the carbon plate, and the close proximity of the whole surface of the zinc to the agglomerates, from which it is only separated by the thickness of the India-rubber bands, renders this a cell of very low resistance, not exceeding 0·2 ohm as a maximum.

The cells are made up either with an outer ebonite jar sealed at the top, as in fig. 5, or with an open stoneware jar,

FIG 5.

as in fig. 6. When put into constant work on a circuit of 10 ohms external resistance, they are said to give a very regular discharge curve and to retain their efficiency for a

FIG 6.

considerable time. Commencing at 146 milliampères, the current is stated to fall in the first three days (72 hours) to 108, after which the diminution is gradual and constant, half the original current, or 73 milliampères, not being reached for 41 days, during which time the cell has furnished a total current of nearly 90 ampère hours.

C

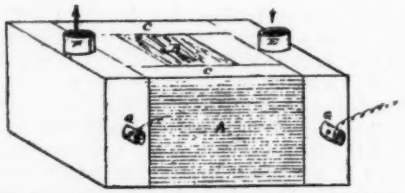
THE APPLICATIONS OF OZONE.

[FROM A CORRESPONDENT.]

(*Continued from page* 237.)

LADD.

There is a strange confusion about the real inventor of this ozoniser, fig. 4, but according to Dr. C. Fox it was devised by Beanes and adapted by Ladd, who disposed the sheets of glass coated with tinfoil on the top of each other.



A, Glass plates coated with tinfoil; B, Top sheet of tinfoil; C C, Glass separators; E, Inlet; F, Outlet; G G, Terminals.

FIG. 4.—LADD.

By a curious coincidence, the paper on this ozoniser was read by General Morin at the Academie des Sciences, on the very day the death of Schönbein, the discoverer of ozone, was notified to the Académie.

The determination of ozone was made by passing the gas escaping from the condenser through a Will's tube containing a titurated solution of $H_2 SO_4$; 0·061 grm. mixed with 1 cc. of neutral potassium iodide (0·1 grm. of iodide.) The amount of potash formed showed the yield of ozone.

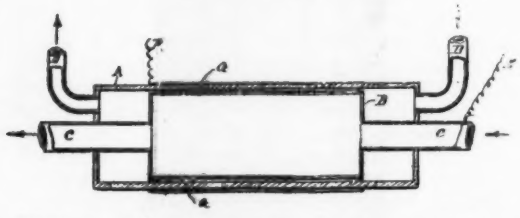
The results of the experiments made by St. Edme and Lhote are interesting and deserve to be mentioned: They stated that they obtained 28 milligrammes of ozone from 10 litres of dry and pure O, and that 10 litres of atmospheric air yielded only 3 milligrammes 8, which if we consider that 10 litres of O represent 50 litres of air, would correspond to 19 milligrammes. They also said that 10 litres of odoriferous gas, gave 36 milligrammes of ozone. These results were obtained by means of a coil giving a 20 to 23 cm. spark.

St. Edme also stated that in the ozone produced by the condensation spark in Beane's apparatus, there was not a trace of nitrous compounds, and that a 3 cm. spark gave to the gas an odour as strong as a 20 cm. spark.

TISLEY, 1873.

I do not think the description of this ozone generator, fig. 5. can be found anywhere but in the *Quarterly Journal of Science*, which I quote, although there is nothing particularly striking in this instrument:—

"On each end of a piece of glass tube of uniform bore is placed a brass cap bored with two holes, and coated internally with shellac. In the interior of this glass tube, and of a diameter scarcely less than that of the tube itself, but not quite so long, is placed a thin hollow brass box with its surface made as true as possible by turning in a lathe. This brass box is placed concentrically with the outer tube, and is



A, Exterior glass tube; B, Copper cylinder; C, C, Inlet and outlet for water; D, D, Inlet and outlet for air; E and F, Wires connected to the terminals of the coil; G, Tinfoil surrounding glass tube A.

FIG. 5.—TISLEY.

completely coated on its exterior surface with tin, the tin being acted on to the smallest extent by the ozone. This hollow box communicates with the exterior of the apparatus, a tinned copper cylinder; the outer tube is also tinned and each acts as an electrode. A current of water flows into the copper cylinder; through the space oxygen passes and is by means of tubes passing through the centres of the caps. It is intended that a current of water should circulate through this box. In the small annular space between the box and the glass tube oxygen is passed from the tubes fitted to the caps. The box itself forms one of the electrodes in connection with an induction coil, and a strip of tinfoil fixed to the outside of the glass tube forms the other.

"Tisley's ozone apparatus consists essentially of a tube, the two ends of which are covered with metallic caps pierced with two holes; this tube is covered with shellac; the inside is ozonised by discharges from an induction coil. This ozone apparatus has been very little spoken of, owing to its want of originality and efficiency as compared with others, of which it was only an imitation. In many publications it is called the Will's ozoniser."

BOILLOT, 1873.

Boillot was the first to use carbon as an electrode for producing the silent discharge. First he coated his two concentric glass tubes with powdered coke or carbon; then, afterwards, he inserted in the inner tube a carbon rod. The outer one was covered with coke or carbon powder adhering to it by means of gelatine. Fig. 6 shows the Boillot apparatus, the metallic wires which connect the two armatures to the poles of the induction coil, and the inlet and outlet for the air or oxygen.

What is worth noting in the Boillot experiments is that he contended that it is preferable to submit air rather than oxygen to the effluvia, because under certain conditions the oxygen of the air is more easily transformed into ozone than pure oxygen, and that the presence of nitrogen facilitates the production of ozone, because the ozone formed by the silent discharge cannot return to the state of oxygen, owing to this fact, that nitrogen repels the atoms which have a tendency to form oxygen again.

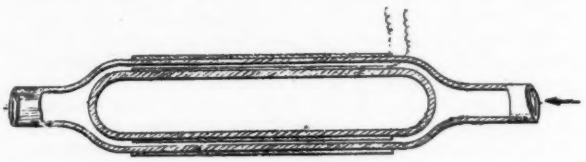


FIG. 6.—BOILLOT.

The following data is supplied by Boillot:—

Temperature of working — 14° C. Rate of flow of gas, two bubbles per second. Source of current, five Bunsen cells. One litre of oxygen gives seven milligrammes of ozone. Five litres of atmospheric air, corresponding to one litre of oxygen gives 21 milligrammes of ozone. Length of spark 34 cms.

HOUZEAU, 1872.

We now come to Dr. Houzeau who is, without doubt, the physicist who may be called the founder of the science of ozone production. We are indebted to him for a thorough knowledge of the nature of ozone, of the best conditions under which ozone can be produced, and for his different

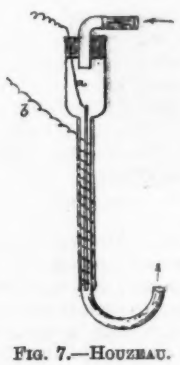


FIG. 7.—HOUZEAU.

ozonisers which are known all over the world and which are to be seen in every laboratory. I will describe the first made by him, a very simple one, formed of a narrow tube,

inside of which is a copper, lead, or better still, platinum wire, 40 to 60 cms. long. A similar wire, and of the same length, is wound round the glass tube. Each of them is connected to the terminal of an induction coil. Length of spark, 2·3 cms. Yield of ozone per litre of odoriferous gas = 60 at + 15° C., to 120 mgms. at — 30° C. With a spark 0·015 mm. long, Houzeau obtained 0·672 gm. of ozone from a litre of atmospheric air in 50 minutes.

It was Houzeau who first ascertained that there is no advantage to be gained in using large and powerful induction coils, and that it is preferable to have several ozonisers worked separately by a coil of smaller size. According to him, good results were yielded when the rate of flow of air through the tube was 1 litre in 4 minutes, and the spark given by his coil, worked by four Bunsen cells, was 0·035 m.

The laws of ozonisation have been formulated by Dr. Houzeau, who described the better conditions of the production of ozone.

The quantity of ozone varies according to the greater or lesser surface of the electrodes.

A large surface of electrodes is not essential to the production of ozone, but the smaller the electrodes the less the quantity of ozone.

When the temperature rises, especially if the electrodes are small, the odoriferous oxygen is destroyed.

The proximity of the electrodes, the length of the tubes, the low temperature, are other factors which influence the generation of ozone.

BERTHELOT.

The ozoniser of this celebrated chemist may be described thus:—An outer glass cylinder is partly filled with acidulated water, in which dips a platinum electrode. A large glass tube is immersed in the acidulated water. This tube is provided with branch tubes for the inlet and outlet of gas. Another tube, but of smaller diameter, fits hermetically into the neck of the last one, also containing acidulated water, to which the current is brought by a platinum electrode.

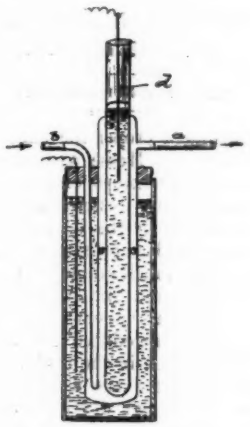


FIG. 8.—BERTHELOT.

The sketch shows plainly the apparatus in section; the air to be ozonised passes through the annular space between the two tubes, between the two electrified liquids.

Berthelot's comments on the electric tension and its continual variation during the intervals between the sparks are very remarkable. What is the influence of these variations, sometimes of several thousands of volts, and of the sudden alternations accompanying them? Are we to believe that the chemical reactions are caused by these alternations and by the resulting shocks and molecular vibrations? or, are they simply produced by a potential difference, by a simple orientation of the gaseous molecules without any action of voltaic current nor rise of temperature, as with the spark, nor sudden change of tension, as with the electric machine and induction coil?

Berthelot's ozoniser is characterised by the electrification of liquids, instead of oxygen gas or atmospheric air in the tubes. If we can compare this apparatus with Siemens's new instrument (1891) we find that they are rather similar, but we must not forget that all tubular ozonisers derive their origin from the ozone tube invented by W. Siemens in 1857.

In all probability the idea of substituting a liquid for the gas was suggested to Berthelot by the experiments made by Du Moncel and by Grove's paper on "Electrolysis through a glass sheet."

"A Florence flask, well cleaned and dried, was filled," said Grove, "two-thirds full of water with a few drops of sulphuric acid added to it, and placed in an outer vessel containing similar acidulated water, which reached to the same height as the liquid in the interior. A platinum wire was passed through a glass tube, one end of which was hermetically sealed to the platinum, but so as to allow a small portion of the wire to project; the other end of the wire was passed through a cork, and the cork fitted to the mouth of the flask.

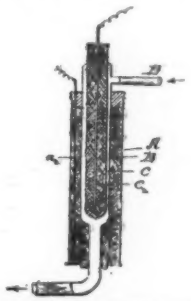
"A similar wire was dipped into the outer liquid, and the two wires were brought respectively into connection with the extremities of a Rhumkorff apparatus. Upon the latter being excited by the battery, a stream of minute bubbles arose from both the platinum points."

Water does neither decompose or accelerate the decomposition of ozone. But the richer the ozone the greater its instability. According to Berthelot, dry ozone kept in flasks at 12° falls from 2·2 per litre to 2·1 within 24 hours; to 1·2 after five days; to 0·4 after a fortnight, and has completely disappeared after seven weeks. The transformation of oxygen into ozone, absorbs 29,600 calories, and this means that the transformation of 48 parts of oxygen into ozone is accompanied by the absorption of this quantity of heat, and that the reverse process evolves this quantity of heat.

This shows, says Berthelot, how great the power of ozone is, when used as oxidising agent, or as developing combustion. The passage of ozone into oxygen, says Mendleieff, should take place easily as an exothermal reaction, like combustion, and this is proved by the fact that at 250°, ozone disappears entirely, forming oxygen.

This storage of heat or energy under the influence of electricity, is remarkable, as a substance more condensed than its generator is formed, and the condensation generally evolves heat instead of absorbing heat, as is the case with oxygen.

BRIN BROTHERS, 1886.



A, B, C, Concentric glass tubes; A and C, contain solid conducting matter, such as plumbago, metal filings, &c.; oxygen or air passes through the space between B and C; the connections are made by means of metallic rods inserted in pulverulent conducting matter contained in A and C.

FIG. 9.—BRIN.

Thus say the inventors, we are able to subdivide what, under ordinary conditions, would be one electric spark of great length and emitted at one point into a very great number of small sparks, emitted through a considerable space, which sparks, passing through the stream of oxygen or air, act on it so as to convert it into pure ozone of great strength where oxygen is used; but where air is acted on the ozone is not so strong, but still will be useful in many important applications in medicine; for example, in producing a curative or purifying atmosphere in hospital wards.

(To be continued.)

Maidstone Electric Lighting.—The action of the Maidstone Corporation in declining, for the present, to undertake the lighting of the town by electricity, in connection with which Mr. Hawtayne had prepared a scheme, has resulted in several electric lighting companies offering to take up the scheme at their own risk.

ELECTRICAL ENGINEERING AND COURTESY.

By SYDNEY F. WALKER.

Some years ago, the writer of this article called attention, in the columns of the Electrical Review, to the folly of wasting brain power during the course of discussions of scientific subjects, upon the feminine object of making their opponents feel.

He now wishes to again call the attention of all who have the true interest of electrical engineering at heart to the same matter. At the present time, electrical engineers have acquired an unenviable notoriety from this cause. It is said, and with perfect truth, that the majority of electrical engineers cannot discuss any subject which may be on the carpet, without giving way to personalities, too often coarse. In place of concentrating their attention upon their opponents' arguments, and how to refute them, in too many cases their whole power is concentrated upon seeing how they can best annoy their opponents; their argument comes second.

Those to whom these remarks apply, forget that no bad argument was ever improved by abuse or by personal references not bearing on the subject, and that many a good argument has lost half its force from being preceded or followed by such references. To take an example. At a recent discussion at the Institution of Electrical Engineers, in which a particular system of distribution was the subject, one member who had strongly advocated the rival system, stated that his opponents, the advocates of the system under discussion, had not succeeded in approaching the system the member in question advocated, in the matter of coal. A representative of the rival system had a complete answer, to the effect that two companies, in different parts of the country, where the price of coal was about the same, consumed exactly the same quantity of coal for the same work, though the stations were run one on each of the rival systems. Simply stated, the force of this argument was almost overwhelming if the figures given proved correct; but the speaker went out of his way to explain that the exponent of the rival system had been enjoying himself, had been waving the red rag, and so on for about half a page of the journal, so that by the time one arrived at the real argument, its force was considerably weakened, and one could not help feeling that the speaker had really not the faith he ought to have in his own argument.

In another part of the same discussion, we have a member gravely assuring the president of the Institution, that there is more joy over one professor who repents, &c. As mild fun, there is no great harm in this, but surely the pages of the Journal of the Institute should not be filled up with matters of this kind and such references as to the waving of the red rag, &c.

If we consider for a moment what the object of institutions such as that of the Electrical Engineers is, we shall see how utterly out of place discussions on these lines are. As the writer understands the matter, institutions of this kind should give a sort of hall mark to their members, and their object apart from that should be the mutual instruction of their members. Unfortunately, the Institution hardly does its duty under the first of these heads, and so long as personal bickerings are dignified with the name of discussions, and the bickerings printed in the Journal of the Institution, it cannot possibly fulfil the latter. When, too, men have worked for a large portion of their lives at one subject, have achieved marked success in that subject, and, further, have been honoured with important positions in the society which deals especially with that subject, surely their remarks should be received with respect. It does not always follow that they are right and a younger member wrong, but their experience and their position should always protect them from personalities and from insult.

If young members wish to add force to their arguments, let them study courtesy and consideration for the experience and the views of others. Nothing adds greater force to an attack, if one must be made, than a full and generous recognition of the claims of an opponent to respect and consideration. There are times, of course, when this is hard. Old members have not always learnt the lesson the writer has tried to inculcate. Opponents in argument often turn and twist one's remarks, take hold of sentences without their context, and generally alter the sense of what one has said, while one has no opportunities of reply. But, in this case, also, patience only is wanted. If our opponent is really worth the trouble of answering, the opportunity is only delayed.

Unfortunately, too, discourtesy and personalities are not confined to discussions at Institution meetings. Writers in the technical journals are too often guilty of the same offence, and apparently for the same reason, with the mistaken view of adding to their arguments, or their criticism of a view on a particular point, at variance with the view the writer of the criticism happens to hold himself. Supposing you believe that a certain statement made by a particular electrician is incorrect, it does not add to your denunciation of the statement to call him names, it only weakens your denunciation. State your reasons for differing from the opinion or the statement, clearly and simply, and you will have done more to counteract the view held by the man you are criticising, if it is erroneous, than you could accomplish by the use of all the adjectives in the dictionary. It is well known that in recent years, what has been termed the new journalism has been created, and that its ways are sometimes peculiar. There may be two opinions on the question whether the new journalism is right or wrong in connection with our everyday life, or with politics; there can hardly be two opinions as to its being utterly out of place in connection with science and engineering, in so far as its cult may lead it to forget the ordinary courtesies which rule in everyday life.

Anything which tends to lighten our labours, to enliven us in our work, is welcome, so long as it is not bought by a sacrifice of the dignity of the profession to which we have the honour to belong. Wit, properly applied, is heartily welcome; but abuse is not wit, no matter how pungent it may be, and we should laugh with, not at our confrères.

The writer would make one remark in conclusion. In private life one simply shuns anyone who treats one with discourtesy; will not that be the simplest and best way of dealing with those who treat one so in public?

IMPROVEMENTS IN SINGLE NEEDLE INSTRUMENTS.

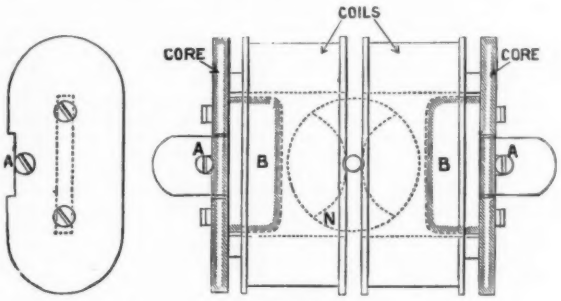
[from a correspondent.]

As a telegraph instrument proper the single needle has been largely superseded by the Morse and other forms of fast-speaking instruments, and except on our railways the use of the needle has become very restricted, and now it is being ousted from short circuits by the telephone. However, as a comparatively large number of single needles may be used on one circuit, it is still much employed on British railways on "omnibus" circuits, and similar coils are also used in a large number of block instruments, signal repeaters, &c.

Since Mr. Spagnoletti introduced his induced needle but little change has been made in the instrument unless it be to substitute double tappers for the usual upright handle. In the last few years the rapid development of dynamos and more especially the publication of Prof. Thompson's lectures on "The Electro-magnet," have done much to place the designing of telegraph instruments on a scientific basis, and as a direct outcome of the study of the above-named work, we may call attention to an improvement in single needles which has now been successfully at work on the Hull and Barnsley Railway for over six months.

A single needle coil may be looked upon as a coreless electro-magnet, the magnetic lines of force induced by the current running principally through air and cutting the lines of force of the permanently magnetised needle at right angles; the direction of the current determining which way the needle should move. By having no iron cores the electric power required to generate a given number of lines of force in the system is very much greater than if there were some, so that if a path were made for the lines of force through iron, the signals would be much stronger with a given current, or, if it were desired not to increase the strength of the signals, much less battery power would be required. On the other hand, the presence of much iron would cause serious retardation in the movement of the needle, as the direction of the lines of force cannot be reversed as

quickly in iron as in air, and care would be necessary to prevent the iron path becoming magnetised under the combined action of the current and the permanent magnets. Last summer experiments were carried out on the above railway with various forms of cores and iron jackets for the coils, and eventually the form shown in the accompanying figure was found to be the best.



N, Needle.

OUTLINE OF CORE CROSS HATCHED.

It is made of the very best Swedish charcoal iron, and after being put together, it is made red-hot and allowed slowly to cool. It is then attached by the screw, A, on to the brass work of the coils; one core on to each coil. The part, B, which enters the coil must be of such a length as to quite clear the needle, else the latter will stick.

On one circuit on the Hull and Barnsley line, containing a large number of single needles, these cores have now been in the principal stations over six months, and there has been only one case where the cores had to be taken out and replaced by others during the whole of that time. Soon after they were put in a thunderstorm occurred, but although the insulation on the barrel of one instrument was pierced the cores were not affected, as one would have expected. The battery power has not been reduced, but it might easily have been, as the needles now come hard over to the pins.

Fears have been expressed that the speed of signalling would be lessened by the insertion of the cores, but although a careful examination of the needle betrays a slightly slower movement in response to the motion of the handle, yet it has been found that the needle still moves quicker than the clerks can read.

The cost per instrument is a mere trifle and not at all commensurate with the increased clearness of the signals, or the saving in battery power.

PROCEEDINGS OF SOCIETIES.

Institution of Electrical Engineers.

AN ordinary general meeting of the Institution was held on Thursday evening, March 9th, 1893, Mr. W. H. PREECE, F.R.S., President, in the chair.

The ordinary general business having been transacted, the discussion on the paper read on the last occasion by Mr. Mordey, was resumed.

Prof. S. P. THOMPSON: I happen to have been reading to-day the proceedings of one of the American societies, and I was very much amused to see a communication to that body read by an engineer who was running a certain Westinghouse station with alternating current machines in America, and he was describing the advantage of some particular system of switchboards, which, he said, was a beautiful switchboard, a real ornament to any station. It was contrived on the following principle:—There were 13 different circuits going out from that station to the lamps, and 13 different alternating motors, and the arrangement was such that by no conceivable possibility could a man, desiring to make a mistake, put one of those machines into parallel with any other machine. There could hardly be a more glorious commentary upon the difference between one country and another than the paper discussed here to-night and that read in America, because the practice in the two countries has gone so absolutely in two different directions.

Dr. FLEMING described a new standard voltmeter intended for the purpose of measuring alternating current power for very large ranges and with very great accuracy; the instrument is simply a wattmeter, in which the shunt coil is excited by means of transformers.

Dr. HOPKINSON: The general method of testing the electrical appliances of that which Mr. Mordey has so well described in his paper before us in a particular case, has really two advantages. The first is that you are able to test your appliances with the expenditure of a very small power, namely, the power which is wasted in those instruments; the other is that you can carry out your test with a very much greater degree of accuracy. Suppose, for example, in the combination of the two appliances there is a loss of 10 per cent., and you can make your measurements with a power of only 1 per cent., then you can make your test of efficiency to an accuracy of $\frac{1}{10}$th per cent. or thereabout. The second advantage I am not sure whether Mr. Mordey puts in sufficient prominence. He rather speaks of it as though it were a question of difficulty of determining large powers by means of a dynamometer. The advantage, however, exists whether the dynamometer be used, or whether you use an arrangement proposed afterwards by Lord Rayleigh, in which all the measurements are made electrically. Mr. Mordey refers to the possibility of testing a single continuous current machine in which there are two equal circuits with separate commutators by connecting those two commutators together in such wise that the power developed electrically in one circuit will be used in the other to generate mechanical power again. A method applied in that way is, of course, as I think Prof. Ayrton pointed out last time, open to the objection that it does not instantly give you a complete test of the mechanical properties of the machine. It has also another objection, and that is this, that if you have two coils connected in that way you will have no distortion of the magnetic field, for the current in one section of the armature will be counterbalanced by the current in the other, and the sparking point of the transformer will be the same as if there were no current at all passing in that machine. Mr. Mordey's method of testing alternators in the single machine is open, to a certain extent, to the same objection, because you do not get that steady and regular distortion of the field that you would get if you had the armature acting simply as a generator or as a motor. If a machine be acting as a generator you will have the intensest field in that part of the pole-piece from which the armature is receding; if the machine be acting as a motor, you will have the intensest field in that part of the field to which the armature is approaching, and it is evident if the armature is acting both as a motor and as a generator, you will have alternately the distortion of the field on one side, and of the pole-piece on the other.

Mr. HARRISON: There is one point I have to complain of in Mr. Mordey's paper. He states that Dr. Hopkinson has predicted years ago that the alternator would run as a motor under the condition of the motor having a higher E.M.F. than the generator, and that statement, I think, has to be very much qualified. As Dr. Thompson has already pointed out, you can take an alternator running at a certain speed, at a certain exciting speed, and it has a certain E.M.F. If the current passes through the armature, the field is interfered with; the armature does not cut the lines that it would have cut, or did cut on open circuit, and the actual E.M.F. set up may be reduced from anything down to nothing. It would be possible to send a current through the armature which would neutralise the field, and no E.M.F. would be set up, so that this statement that a 100-volt armature can drive a 200 volter as a motor, is true only with the qualification that when it is doing so, the 200 volter is not giving 200 volts. But I have long suspected that there is a great deal more in the reactions which go on between the armature and the alternator and the field than is generally supposed. At Faraday House we have an old Siemens alternator, with which I have recently been trying some experiments; we excited the field of this alternator from a secondary battery, which, of course, gives a perfectly steady current. The armature is then run up to proper speed by the gas engine synchronised with the current of the London company's mains, made to run as a motor, and the belt thrown off. Now, under proper conditions, this effect can be produced in a very marked degree. The alternating current from the armature begins to throb or pulsate, and increases, and what has not been referred to, and I do not think it is generally known, is this, that the current in the fields does the same thing. The needle of the ammeter in the direct circuit will pulsate in the most marked manner, and as this pulsation increases, the current in the armature increases at the same time. I am of opinion that this hunting of the current is an exceedingly important factor in the running of central station mains, whether alternators are connected abreast, or used as generators.

Mr. SWINBURNE: I cannot accept either of Mr. Mordey's experiments as to his single coil, as they do not agree with other experiments made on alternators. Turning, now, to the efficiency, the bearing losses are not given, as the belt is not on. Mr. Mordey seems to think an efficiency test should be taken with the belt off. I would submit that is absurd. The loss due to the belt occurs in practical use, and must therefore be included in the machine losses. If not, where is it to come? The engineer may equally justly say his engine should be run without a belt, because the belt is not part of the engine. Of course, the efficiency comes out higher without the belt, but the too common habit of making out a high paper efficiency is to be deprecated, as it is really a kind of misrepresentation. Why do people, for instance, talk of the "electrical efficiency" of a machine? The purchaser wants to know the losses in the whole machine, not the losses in one portion of it. Next, the losses in the armature are not equal to the full load losses, unless the field is in the same condition as at full load. I mention these points not with the view of raising small objections to a most valuable system of testing, but to guard against the thoughtless inaccuracy of assuming that because a machine at full load has its full armature current, a test which gives its full armature is necessarily equivalent to a full load test. These points being remembered, Mr. Mordey's system provides the electrical engineer with a most valuable means of approximately testing large dynamos. There is a method of testing which is often useful, and is not as well known as it ought to be, viz., running at full current but low speeds. It satisfies many of the conditions of full load testing. Before leaving the subject of back to back testing, a suggestion may be made as to further developments. Why not apply the principle to steam engines? Next time a twin engine is built for an Atlantic liner, let us hope that the engines will be coupled in the

erecting shops with their steam pipes coupled together, and their exhausts, the whole being run at full load, without condensation by a donkey boiler. Suppose, however, instead of showing engine builders how to do their work, we take a humble attitude, and learn how to build dynamos so that we can confidently send them out without even trying them round. I cannot agree with Mr. Mordey as to the details of parallel running. To secure parallel running, you must not consider the dynamos only, but the whole station. A factor commonly neglected, and not referred to by Mr. Mordey, is the engine governor. To run a number of alternators in parallel off separate engines, each with its own independent speed governor, is as foolish as to run independently governed engines on to one shaft. The relation of steam admission to speed cannot be the same in a number of governors, and uneven distribution of power must occur. This cannot be corrected by altering the dynamo excitation; that alters the armature current, but not the power in this case, as it does not affect the speed.

Mr. Crompton: I believe the extreme difficulty of getting governors of equal sensibility, that is, that will respond to a change of pressure or change of speed at an equal rate, has been the main cause why alternators have not been able to be easily arranged, so that they divide the load equally. It is a very easy thing for alternators to be brought into parallel, thanks to the efforts of men like Mr. Mordey, but hitherto it has not been an easy thing to keep them equally loaded, and that is the great difficulty that is existing at the present time. Mr. Willans was working with various forms of electrical governors for doing this work, but I think the view he took latterly was that it would be better to do away with separate governors completely, and put one governor on the main steam pipe; and if I follow Mr. Mordey rightly, that is what he would require in this instance. Of course, that does not meet this difficulty; engines differ somewhat in their internal friction. One engine may be better lubricated than another, and consequently there is a tendency for the engine worse lubricated to lag, although taking the same steam the other is taking; consequently that would fall behind, and consequently do less load than the other. That difficulty is not met by the proposal of one common governor, but I confess it is the only solution of the problem I see at the present moment.

Mr. Mordey: There is one point to which I do not feel competent to reply, and that was raised by Mr. Harrison, and as it really is criticism of some of the results Dr. Hopkinson referred to, I should be very glad if Dr. Hopkinson could briefly reply to that now, or add it to his remarks.

Mr. Kapp, Dr. Sumpner, Mr. Bayley, Mr. Weekes, and Mr. Miller also took part in the discussion.

Mr. Mordey having replied, the meeting adjourned

LEGAL.

Thomas Connolly (Senior) *v.* The International Okonite Company, Limited.

In the Manchester Nisi Prius Court, on Friday last, this case came before Mr. Justice Wills and a special jury. Mr. Shee, Q.C., and Mr. Sutton for the plaintiff; Mr. Gully, Q.C., M.P., and Mr. Pickford for the defendants. This was an action for damages for breach of agreement, arrears of salary, and expenses.

The plaintiff and a Mr. Shaw were formerly in business as electrical engineers in Newton Heath. In 1890 they sold the business to the defendant company for £28,000. The plaintiff retained a large interest in the business. He was also employed as works manager for the company in Manchester at a salary of £700 for seven years certain, with a commission on the net profits of 5 per cent. the first year (after deductions for advertisements), 3 per cent. the second year, 1½ per cent. the third year, and 1 per cent. afterwards. Mr. Shaw was to be retained to assist him as manager of the commercial department; one of the plaintiff's sons was kept employed as chief electrician, and another son acted as assistant manager of the works. The plaintiff afterwards travelled in the interests of the company, and went to America, where they also had works. On his return he complimented his sons on the way the business had been conducted in his absence. The company had branch business works in London. Later, the board of directors of the company became dissatisfied with the plaintiff's services. There had been a decrease in the profits, and on September 7th, 1892, he was dismissed from his position as manager. The defendants had paid £250 into court.

In cross-examination the plaintiff said he sold all his trade secrets, the lease of the premises, and, in short, everything relating to the business to the company. Okonite was an insulating material for cables, composed of India-rubber and other substances. Mr. Stevens was the manager of the company's works in London. Plaintiff admitted that he had not sent up a certain book to the directors of the company in London when asked to do so. It might be that the directors were under the thumb of Mr. Stevens.

Mr. Gully: Mr. Stevens must have a big thumb, then. (Laughter.)

The Judge: You seem to have wanted to have the directors under your thumb?

Plaintiff: No. (Laughter.) Plaintiff admitted having disobeyed the orders of the directors in not having delivered up to them books containing recipes of all the compounds, ingredients, and mixtures used at the works. He could give no reason for this beyond having quarrelled with Stevens.

The Judge said the directors had a right to ask for the books, and the plaintiff, by his own admission, had disobeyed their orders without reasonable excuse.

The Jury thereupon, without waiting to hear further evidence, found that the dismissal of the plaintiff was justifiable, and they therefore gave a verdict for the defendants on that point.

His Lordship gave judgment for the defendants, and said that the money paid into Court for arrears of salary and expenses should remain there pending the taxation of costs.

John Thomas Connolly (Son of the above Thomas Connolly) *v.* the International Okonite Company, Limited, and Charles Hibbert.

This was an action for breach of agreement, arrears of salary, expenses, and slander, the slander being alleged against Mr. Hibbert. The same counsel represented the parties as in the previous case.

The plaintiff is the son of Mr. Thomas Connolly, and when the company took over the works it was arranged that the plaintiff should be engaged for five years, his salary commencing at £22 per month for the first year, £24 per month for the second year, and £27 per month afterwards. After the company discharged Mr. Thomas Connolly, it was alleged on the part of the plaintiff that needless fault had been found with him in the discharge of his duties. Complaints were made that he did not come to the works before 8 o'clock in the morning; Mr. Stevens, in introducing Mr. Hibbert, the new manager, to him, had told him that Mr. Hibbert was an experienced man, and knew more than he or his father about the business; that in future he would have to obey his orders, observe the ordinary hours of the works, sign off and on, &c. He was also charged with having taken a holiday without permission, and with rank insubordination, and finally was dismissed. The plaintiff held that he had been improperly dismissed. There had also been some correspondence, and it was in respect of one of these letters of Hibbert that he complained of being slandered. In cross-examination the plaintiff admitted that he had asked whether Mr. Hibbert was a competent person, and he wished Mr. Stevens to understand that he did not consider Mr. Hibbert a fit person to take over the management of the works. He did ask what would happen in the event of his refusing to obey Mr. Hibbert's orders, and was told that it would mean his dismissal. The next day he went on with his work, and did not refuse to do what he was asked to do, but was dismissed.

Mr. John Shaw gave evidence of a corroborative character, and said that after the introduction of Mr. Hibbert to the plaintiff, Mr. Stevens said to Hibbert, "You see what sort of a temper the young man has that you have to deal with; the probability is that he will discharge himself."

Mr. Gully, for the defendants, said no doubt the plaintiff had felt annoyed at the discharge of his father, and was prepared to look with a jealous eye upon anyone who came to fill his father's place.

Mr. Stevens said it was true that he had written stating that he would put a sharp chap under the plaintiff to pick up all the information necessary, and then send him (plaintiff) away. He thought that was a fair thing to do. (Laughter.)

The Judge: I know one of the directors who would not think so.

Mr. Shee: You have got rid of the Connollys?—Yes.

And has Hibbert gone, too? (Laughter).—Yes.

Mr. Hibbert said he left the company because Manchester did not agree with his health. The cause of plaintiff being dismissed was as follows: Witness asked plaintiff to make out some estimates which were required, and offered him a sheet of foolscap upon which to do the work, but the plaintiff made no attempt to take it; he walked away from it, and wanted to talk about his position in the works, which had been already defined, and he declined to bandy words with him. The plaintiff declining to go on with his work, he (witness) considered him guilty of insubordination, and discharged him.

Mr. Shee said it might have suited the defendant company to get rid of the plaintiff, but they must pay him what was due under his agreement.

Mr. Gully said the defendants had paid enough money into court to cover the expenses which the plaintiff had incurred in a journey to America.

The Judge said that only left the jury two points to consider, viz., wrongful dismissal and libel.

The Jury gave a verdict for the plaintiff for wrongful dismissal, and for the defendant on the libel; damages for wrongful dismissal, one year's salary, £288.

Woodhouse and Rawson United, Limited.

In the Chancery Division of the High Court of Justice, on Friday the 10th inst., Mr. Justice North, at the instance of debenture holders, appointed Mr. Leslie receiver and manager of this company's undertaking.

Mr. Cozens Hardy, Q.C., appeared in support of the motion, and stated that default had been made in payment of interest on the debentures, and there was no doubt the company was in a most impecunious condition.

Mr. Method, for the company, was willing that Mr. Leslie might be appointed for one set of debenture holders, but asked that another set might be at liberty to appoint some one on their own behalf.

Mr. Justice North: What is the business?

Mr. Cozens Hardy: Electrical engineers.

Mr. Justice North made the order mentioned, saying that the receiver could be directed to keep separate accounts if necessary, and gave leave to the receiver and manager to borrow £1,000 to keep the business going.

COLEMAN AND ANOTHER *v.* SHAW AND CONNOLLY.

On Wednesday, last week, this case came on at Manchester, before a judge and jury. Mr. Ambrose, Q.C., M.P., and Mr. Sparrow were for the plaintiffs, and Mr. Parry was for the defendants, in this action, which was brought to recover damages for breaches by the defendants of certain covenants contained in a deed of apprenticeship.

Mr. AMBROSE, Q.C., M.P., in opening the case, said the plaintiffs were John Coleman, a former member of the Newton Heath Local Board, and his son, Albert Coleman, a youth, who sued through his next friend, and the defendants formerly carried on business as electrical engineers at Varley Street, Miles Platting. Under an agreement dated November, 1888, the younger plaintiff was apprenticed to the defendants firm for four years and a half to learn the business of an electrical engineer. His father paid £100 as premium with him. Instead of teaching him his business, he was, according to his own statement, generally "running about labouring." Early in 1890, Messrs. Shaw and Connolly sold their business to the International Okonite Company, and they became servants of that company in the capacity of managers of certain departments. The younger plaintiff also continued working for the company for some months, when his position as an apprentice was then brought under the knowledge of the managing director of the company, who at once declined to recognise him as an apprentice, and, according to the plaintiff's story, declared that if that were so he had been badly treated.

The PLAINTIFF (Albert Coleman), in reply to Mr. Sparrow, said that he was never taught his business as he ought to have been. His work was generally that of a labourer. In reply to Mr. Parry he said he had attended classes at the Technical School, and he had been "plucked." He denied that he had ever been impudent to Mr. Connolly, nor would he admit that there were frequent complaints about his "larking" instead of minding his business.

A fellow-apprentice named METCALFE, who was called by the plaintiffs, said he joined Messrs. Shaw and Connolly a few months before Coleman, and now as a journeyman he felt that his apprenticeship had been of great use to him.

Mr. PARRY, for the defence, was contending that the plaintiff was "fiddling" about instead of looking after his business, when his Lordship interrupted by saying that, supposing all this were true—supposing that one was an industrious and the other not an industrious apprentice—that did not get over the breach of the covenant in the apprenticeship deed. Mr. Parry said he quite saw that difficulty.

His LORDSHIP: Surely then it is a matter which counsel can arrange between them.

Mr. PARRY said he would prefer the matter went to the jury, and having addressed the jury on the subject, the latter found for the plaintiff, with £55 damages. Judgment was entered accordingly, with costs.

NOTES.

The Liverpool Overhead Railway.—General Hutchinson, R.E., Major Yorke, R.E., and Major Cardew, R.E., inspectors for the Board of Trade, a week or so ago, completed an official survey of the new Overhead Railway. The inspectors subjected the line to a severe test, causing a load to be carried that was 50 per cent. beyond the heaviest weight that the directors propose to allow to be carried. The line was opened for traffic on Monday last week. The number of passengers carried on the first day was 17,541, the receipts being £164 3s. This was with a ten minutes service.

Toxteth Electric Lighting.—The week before last, at the Law Association Rooms, Cook Street, Major Cardew, Board of Trade Inspector, held a private enquiry relating to the dispute between the Toxteth Park Local Board and the Liverpool Electric Supply Committee as to the specifications and conditions upon which the company shall lay mains, &c., for supplying electric light to the board's district. The board and the company had failed to agree as to the conditions to be observed, and the authority of the Board of Trade was invoked in order to settle the disputed points. The inspector heard evidence and arguments as to the details in dispute, and will no doubt report to the Board of Trade in due course.

Rothesay Electric Lighting.—A pessimistic correspondent of the *Rothesay Express* signing "Caution," considers that "The hitherto questionable success of this new kind of light in Glasgow ought to be a reminder to the Rothesay folks not to push the movement, but to wait on a bit. Indeed, there are authorities who think that were the old gas to have as much attention paid to it as the electric light receives, the gas would show as well. Anyhow, there are certain institutions in the city that would have saved thousands of pounds had they been in less hurry."

Woolwich Electric Lighting.—There is a probability of the electric light being introduced on a large scale in Woolwich, a local company having been formed with that object. Already notices have been served on the Local Board of Health of the company's intention to lay mains in High Street, Hare Street, Powis Street, Green's End, New Road, Beresford Square, Wellington Street, and other principal thoroughfares. The generating station will be in Globe Lane.

Dundee Electric Lighting.—On the 2nd inst. the engines and dynamos at the Dundee electric lighting works were running steadily, and the current was kept on continuously from early afternoon till eleven o'clock at night. The various junction and feeder boxes were inspected in the course of the day, and found to be in a satisfactory condition. Many fresh applications have been made for the new illuminant since the current was first switched on. The large drapery warehouse in Wellgate belonging to Messrs. William Hunter & Co. has just been fitted up. In all 76 lamps have been arranged throughout the premises, and the light is equal to 220 lamps of 16 candle-power each. Messrs. M'Leod & Co., Dundee and Glasgow, were the engineers, and the work was carried out under the superintendence of Mr. J. E. Marr.

The ceremony in connection with the public lighting of Dundee by electricity took place on Tuesday evening last. The current was turned on by Lord Provost Mathewson. The lamps on the High Street have now been placed in position, and the other arrangements are practically completed.

A Case of Temporary Aberration.—A few weeks ago we reproduced a note on "The Proper Use of Terms" from the *Electrical World*. The following letter has since appeared in the columns of the New York *Electrical Engineer* from the pen of W. J. Jenks, of New York City:—

"Did the editor or publisher of the *Electrical World* manufacture his little list of first page paragraphs in the issue of February 4th under the stress of an enlarged cranium too tightly incased in his ordinary hat? Hear him think aloud:—

Proper Use of Terms.

> We often notice, especially in papers written by mechanical, civil and other engineers who are not electricians, that they use electrical terms incorrectly. We refer at present more particularly to the loose way in which the terms kilowatt and kilowatt-hour are used. A kilowatt is a unit of power or activity, and includes the element of time. On the other hand a kilowatt-hour is a unit of work or energy, and is as a unit entirely independent of the element of time; it is precisely like the terms foot-pounds, or horse-power-hour, or joule, into which it is directly convertible.

Could a man get mixed up much worse? Can anybody conceive of how a volt-ampère, or any number of volt-ampères, can 'include the element of time'? May not a watt be as truly a watt if expended only for $\frac{1}{1000000}$th of a second as if such a rate of expenditure were kept up for a year? Can the said editor, during the lucid intervals when his hat fits him, reflect that 'a kilowatt-hour' is as a unit entirely independent of time, when time is one of its factors? Is it really 'precisely like the term foot-pounds,' which does not include time (but which may mean a very rapid or a very slow expenditure of energy, according as it is coupled with a rate), and *also* precisely like 'horse-power-hour' which always indicates work done at a definite rate per second and also for a definite total period? Let our friend, the editor, remember that every tyro in electrical study should understand that as long as volts represent difference of potential, and ampères represent simply and only the number of volts expended in each ohm of the resistance, the product of this total potential difference multiplied by this rate of potential expenditure for each ohm (not a rate as referring to time) will give the watts, which are still watts, no matter how minute or how vast the period during which this degree of activity continues. Hence a watt or a kilowatt has nothing to do with time, and the *World* should be careful lest its honoured editor places himself in the category of those whom he characterises as 'mechanical, civil and other engineers who are not electricians'—who, by the way, sometimes do write papers which electricians do well to study with care."

Lectures.—Before the Edinburgh Merchants' Association recently, Mr. J. M. Turnbull concluded reading his paper on the "Comparative cost of Electric Lighting and lighting by Gas." The first part of the lecture was given at a previous meeting.

On Tuesday week a lecture on "Electricity" was delivered in the Broomloan Hall, Govan, by Mr. W. McWhirter.

Last Friday week, at the University College, Nottingham, Prof. Robinson delivered a lecture on "Domestic uses of Electricity."

Mr. W. W. Haldane Gee, of the Electrical Engineering Department of the Municipal Technical School, delivered a lecture last Tuesday week in the Newton Heath Public Hall, on "The Electric Light."

At the opening meeting of the session of the Goldsmiths' Institute Engineering Society, the president, Sir Frederick Bramwell, gave his inaugural address, in the course of which he made some lengthy remarks upon the condition of the electrical industry.

A lecture was given on Tuesday last, March 14th, in Kidbrook Parish Room, on "Electricity and Some of Its Uses," by Mr. W. Geipel, M.I.E.E. The lecture was illustrated with various electrical experiments.

On Wednesday, last week, Prof. G. F. Fitzgerald delivered a lecture on "Alternating Currents," before the Royal Dublin Society.

At the meeting of the Royal Meteorological Society, held on Wednesday Evening at the Institute of Civil Engineers, a lecture was delivered by Mr. Shelford Bidwell, F.R.S., entitled "Some Meteorological Problems," the discourse being devoted mainly to the subject of atmospheric electricity. The lecture was illustrated by numerous experiments.

The fifth of a series of science lectures was delivered at the Industrial Hall, Dewsbury, on Tuesday last week, by Dr. T. J. Riley, his subject being "Electric Lighting."

Wiring Formula.—In a little pamphlet recently issued by Taylor, Goodhue and Ames, of Chicago, Ill., the following formula is given, says the New York *Electrical World*, for the benefit of those desiring a simple method for calculating leads for multiple distribution:

$$C_M = \frac{21{\cdot}21 \times C \times D}{E}$$

C_M = area of wire in circular mils., 21·21 = constant for 2 mil. feet of copper wire, C = current in amperes, D = distance in feet to lamps, E = volts loss in conductor.

Edison and the Speculators.—At an interview with the representative of an important New York journal recently, Edison stated that in consequence of the decision in the Bate Refrigerator and the Edison Incandescent Lamp patents, by which it was held that the expiry of a foreign patent did not annul his United States patents in the phonograph, he is now placed in a position to control the whole of the phonograph business from the initial patents of 1877. He also stated that the speculators, who had tricked him out of his rights and obtained from the American public for those rights over $17,000,000 through various subsidiary companies, which have in a large number of instances become bankrupt, finding there is nothing more to obtain, have left all the original stockholders "in the cold." He is now taking hold of the business himself, and has become president of the North American Phonograph Company, and his secretary, A. O. Tate, is vice-president, and it is his intention of running the business on similar lines to the typewriter, selling phonographs all over the world. He is entirely out of sympathy with the speculators in Europe, who are trying to obtain from the public some millions sterling for the rights of the phonograph, because the phonograph can never pay a dividend on such large sums. While the phonograph is a wonderful apparatus, yet from an investment point of view it must be thoroughly investigated. He claims that with a capital of £50,000, he could supply the whole world with phonographs. In conclusion, he significantly remarks: "The next invention I bring out I intend to develop with my own capital, and not permit the speculators to use my name and prestige to rob the public for their —the speculators—benefit only."

Falmouth Electric Lighting.—A report on the electric lighting question has been prepared by the committee appointed for that purpose. The sum at present expended on gas lighting is £530 per annum; for electric lighting it is stated that it will be necessary to expend £600 or £650 per annum. The committee, it seems, propose the transference of the powers to some firm or company. Any decision in the matter, however, is postponed for further consideration.

Newcastle Electric Lighting.—At a meeting of the City Lighting Committee on Tuesday last week, the whole question of the lighting of the town was raised. A sub-committee was appointed to consider the question, to obtain the necessary information, and to present a detailed report. A meeting was arranged to be held with the manager and directors of the East End Electric Lighting Company, with respect to the lighting of Grey Street. It is proposed to light this important thoroughfare with four or six large electric lamps. At the same meeting the committee gave orders for a special electric lamp to be fixed in St. Nicholas' Square, near the Cathedral, in place of the large gas lamp at present there.

Reading Electric Lighting.—According to a statement made by the Town Clerk at a Council meeting recently, the Board of Trade are prepared to protect the public interests by making certain provisions in the order to be granted to the electric lighting company. The committee of the Council had proposed an amendment to the effect that if the time ever came for purchasing the company's undertaking, it should not only be free from mortgages, but debentures and other like charges. This, the Town Clerk stated, was a novelty to the Board of Trade, and though the amendment was not accepted in the form in which it had been prepared, the Board of Trade were prepared to give effect to it. The Town Clerk expressed his belief that the Council would get substantially what was wanted. It was stated that the Council were not to get a rental from the company.

Rotherham Electric Lighting.—An electric lighting committee has been appointed to inquire into and report to the Council upon the cost of an electric lighting plant, the most suitable site for same, to ascertain the probable number of lights to be taken by consumers, the probable revenue, and any other information likely to assist the Council in deciding whether it is advisable to establish the electric light in the borough. The mover of a resolution to this effect at the Town Councils' meeting said that the cost, roughly speaking, for boilers, engines, dynamos exciters, switchboards and condensing plant was about £7,500. Transformers were put down at £750, and underground mains might mean £3,000. There was also the cost of buildings, say, £2,000. Altogether the outlay might mean £15,000. He calculated that after all expenses there would be a profit of £2,000, whilst the Council would have provided a boon and a blessing far superior to gas.

Hysteresis and Dielectric Viscosity of Mica.—A paper of rather exceptional interest was presented by Mons. P. Janet at a meeting of the Paris Academy of Science, on February 20th, the subject being "The Hysteresis and Dielectric Viscosity of Mica for Rapid Oscillations." After alluding to the great progress realised during the last few years in the science of magnetism, and attributing it to the introduction of the notion of hysteresis and of magnetic viscosity by Ewing, Mons. Janet proceeds to refer to the well known experiments of Bouty, Warburg, and Ewing. He compares the differences of potential and resulting charges during rapid oscillations, as determined by the apparatus described in these pages last year (or *vide Comptes Rendus*, Vol. cxv., p. 875). This comparison reveals a lagging of the charge behind the potential, both increasing and decreasing. With the values obtained in experiments with a mica condenser, Mons. Janet constructs a curve, and endeavours to trace in it a connection with Ewing's well known curves of magnetic hysteresis. He has evidently struck out a very suggestive line of research, and we are glad to note that he proposes to give it a full investigation.

Portrush Electric Lighting.—It has, so we understand, been resolved to appoint a competent engineer to prepare an estimate as to the probable cost, and to go into the question of providing the electric lighting machinery.

Kensington Electric Lighting.—The question as to whether the vestry shall take the electric lighting into its own hand is to be considered in committee. The Kensington Electric Lighting Company have stated that they are prepared to complete a supply for the district within 18 months.

Coventry Electric Tramways.—It seems that unless certain "suggested modifications" made by the General Works Committee, in respect of the proposed agreement between the corporation and Mr. Graff-Baker (proprietor of the Coventry and District Tramways) are withdrawn, the expected working of this line by electricity will not be accomplished. A perusal of some of these modifications, which are given in the *Coventry Herald*, convinces us that a number of them are superfluous. The council asked for assurance that Mr. Graff-Baker has really paid the £6,000 purchase money; information as to any contracts or independent estimates for the equipment of the line that have been prepared or entered into; they ask for a 15 minutes' service between Coventry station and Longford; request an assurance that no outside advertisements shall be displayed on the cars; no posts to be used in certain stipulated streets; the 21 years to be altered to 16 years as the period during which the corporation shall not exercise its power of purchase. Mr. Baker is to undertake, if required by the corporation, to sell to them the whole undertaking, with plant, &c., complete, at the expiration of 5, 10, or 16 years, at a price to be ascertained as follows:—The actual cost of the undertaking to Mr. Baker at the time of the inauguration of the electric service to be taken as a basis, and a deduction to be made for depreciation of 5 per cent. if the purchase takes place at the end of five years, of 10 per cent. if at the end of 10 years, and of 15 per cent. if at the end of 16 years. Clause 9 to be altered to provide that the tramways shall be equipped and started within nine months from the date of agreement, under a penalty of £5 per day. Upon these, and a number of other suggested modifications being suggested to Mr. Graff-Baker, he naturally replied that the alterations "do not appear to be suggested upon the basis of either public policy or practical business principles. I cannot entertain them at all. . . . I must request you to lay a copy of your letter of the 21st, and this of mine before the council at their next meeting, and to inform the corporation of Coventry in council that, unless they can accept the draft agreement as settled between the Assistant Town Clerk and myself, prior to your letter of the 21st inst., I cannot do any more in reference to electricity, but shall have to take such action, as authorised by my Acts of Parliament, that will enable me to give a commercially profitable steam service on my tramways."

Antimony in Pure Copper.—In the technical elaboration of copper by means of electrolysis, small quantities of antimony—a metal invariably accompanying copper—are always precipitated simultaneously. All commercial brands of electrolytic copper that have been examined by W. Hampe, are stated by him to contain along with 99·94 to 99·99 per cent. of copper, a quantity of antimony varying from 0·007 to 0·02 per cent. That this is no fault of the manufacturers of "pure copper" has been fully demonstrated by Hampe recently in some careful laboratory experiments. He does not hold out much hope that this contamination with antimony will ever be eliminated in practice, but he asserts that if the electrolysis be not pushed to the extreme limit, less antimony will be precipitated. The tension and the density, as he puts it, of the current, are not without influence, and it is to be hoped that he, or some other competent investigator, will endeavour to find out precisely what this influence is, and how it is exercised, for there is no question that, small as these percentages of antimony undoubtedly are, they are not without their effect upon the electrical properties of the copper.

Folkestone Electric Lighting.—We hear that once more the Town Council intend to consider the question of electric lighting the town.

Belfast Electric Lighting.—Prof. Kennedy's report was discussed at the last meeting of the Public Health Committee. The Town Clerk is writing to Prof. Kennedy for further information.

The South American Cable.—We understand that the ss. *Dacia* arrived off the Silvertown Works on Monday last, 13th inst., after repairing the South American Cable, which broke down suddenly on Christmas Day. All is satisfactory.

The House of Commons Clock Tower Light.—In the House of Commons last Saturday, it was stated that the question of replacing the gas light in the clock tower by a flashing electric light, such as that now used by a theatre in Shaftesbury Avenue, would be considered.

Parliamentary Notes.—The First Commissioner of Works, it is stated, intends to ask for a vote of £12,000 to extend the electric lighting arrangement in both Houses of Parliament. Only £1,600 will, however, be expended in the coming year. The cost of electric lighting last year in the House of Commons was £1,800. The gas in both Houses and in the offices and halls pertaining thereto cost £2,775. Oil lamps, almost entirely superseded by the electric light, cost £1,300 a session.

Blackpool Electric Lighting.—The application of the Corporation to borrow £26,000 for electric light has been sanctioned by the Local Government Board. The erection of the electric light station, and other work incidental to the installation, is being rapidly proceeded with. Mr. E. Woods, of Manchester, has got the contract for the iron roof, and it is hoped that the light will be installed on the promenade in July. The mains are laid on the promenade.

Paris Electric Light Stations and the Emission of Smoke.—The smoke emitted by the electric lighting stations in the interior of Paris has for some time now been made the subject of numerous complaints by the inhabitants of the different neighbourhoods. The Municipal Council last week once more had the matter under its consideration, and after a lengthy discussion as to how to get rid of the smoke arising from the stations in question, two propositions brought forward by Messrs. Despatys and Vaillant were adopted. These propositions called for the continuance of the researches as to the absorption of the smoke by different processes, and the classification of trade establishments which were of a nature to be hurtful to the public health by the smoke which they emitted.

The Lamp Situation in America.—We learn from our American contemporaries that lamp manufacturers, outside the General Electric Company, are not disheartened at the result of the late decision of Judge Colt in the Goebel case, and they intend to carry on the war to the bitter end. This last case was, of course, merely in respect to the granting of an injunction, and the defendants claim that at the final hearings they will be able to present much stronger suits by reason of the longer time available for preparation. One of these hearings was set down for February 20th at Chicago, and another, in St. Louis, for February 24th. In the latter, the line pursued was to be the same as in Boston, with the addition, it is said, of some new evidence hitherto inaccessible. Meantime the General Electric Company has the situation to itself. Its past conduct does not seem to have brought it much love or respect from its collaborateurs, and its latest acquisition, the Green electric railway patents, is regarded as foreboding no good to electrical interests at large. [The Green patents, referred to by Mr. Tanner in our issue of February 24th, seem to be fundamental, and therefore important.] However, the company appears to be doing its best to conciliate the Edison licensees, and it is to be hoped that it will use its power wisely in every direction.

Electric Lighting of the Victoria Embankment, &c.—The London County Council have approved of the appropriation of a piece of land adjoining the Charing Cross District Railway Station for the purposes of a generating station in connection with the electric lighting installation for which the Council sought powers in its General Powers Bill of this session for the Victoria Embankment and ornamental gardens and the Westminster and Waterloo bridges.

City and South London Railway Bill.—In the House of Commons on Thursday, 9th inst., on the motion of Mr. M'Lagan, it was resolved: "That it be an instruction to the Committee on the City and South London Railway Bill and City and South London Railway (Extension of Time) Bill, that they have power, if they think fit, to consolidate the two Bills into one Bill."

A Select Committee of the House of Commons, on Monday last, passed the preamble of a Bill promoted by the City and South London Railway Company, sanctioning an extension of time for completing the authorised extension of this railway from Stockwell to Clapham. The Select Committee also passed the preamble of a second Bill, promoted by the same company, authorising an extension of their railway to the City Road, Islington.

The company's Bill for an extension of their system to Islington came, on Wednesday last, before Sir John Kennaway's Committee of the House of Commons for the discussion of clauses. Several new clauses were inserted in the interests of the Corporation of London and other opponents, and with these and other amendments, the Bill was ordered to be reported.

Obituary.—One of the most noteworthy figures in the American electrical field has passed away by the death of Dr. Norvin Green, president of the Western Union Telegraph Company. Dr. Norvin Green was born in Floyd county, Ind., April 17th, 1818. When 14 years of age Norvin kept the books of his father's office. Before he attained his majority the young man secured a contract to cut cordwood for steamboats in Hunter's bottom, near Madison, Ind. He made enough on his contract, to carry out which he employed a small army of men, to give him a medical education. He secured this at the University of Louisville, graduating in 1840. He served as a representative of Henry county in the Kentucky Legislature from 1849 to 1852. He was a presidential elector in 1852. In the following year Dr. Green became interested in the telegraph, a business with which his name has become inseparably associated. In 1853 the condition of the telegraph companies in the country was such, that no one ever thought of realising any profit on the schemes, and Prof. Morse told Dr. Green, in later years, that the first money he ever received from his invention was a cheque for dividend money sent him by Dr. Green. Dr. Green displayed his abilities in organising the shapeless and diverse interests in one paying company. Soon after the Morse invention two companies were organised, one styled the New Orleans and Ohio Telegraph Company, controlled by Dr. Green, and the People's Telegraph Company. After a bitter warfare, the companies were consolidated. The Southwestern Telegraph Company took the field occupied by the two companies, under the management of Dr. Green. The work of organising was pushed, until the company became one of the best paying properties in the country. In 1866 the Western Union Telegraph Company bought it, making it a part of its systems. Dr. Green engineered that deal, and was elected vice-president. For a few years after this he engaged in railroad matters, becoming president of the Louisville and Cincinnati Short Line. In 1870 this road was sold to a New York syndicate. Dr. Green then went to New York, and actively engaged in the affairs of the Western Union Telegraph Company. In 1877 William Orton, then president of the company, died, and Dr. Green succeeded him. From 1884 until 1887 Dr. Green served as the first president of the American Institute of Electrical Engineers.

Advices from the Hague, says the *Financial Times*, announce the death of M. J. P. Hofstede, the head of the Department of Posts and Telegraphs. The deceased represented the Netherlands at all the International Congresses on Posts and Telegraphs held in recent years.

Chicago Exhibition Congress.—Sir Benjamin Baker, Vice-President of the Institution of Civil Engineers, will represent the Institution at the Engineering Congress, to be held at Chicago during the week commencing July 31st.

A Good Resolution.—The following resolution was unanimously passed at an ordinary meeting of the Council of the Royal College of Physicians, held on 9th inst.:—"That it is degrading to the profession and injurious to the public interest that Fellows or Members of the College should associate themselves with trading institutions for the treatment of disease and allow their names to be advertised in support of the practice of medicine and surgery by persons not legally qualified."

Hospital Electric Lighting.—Baron Hirsch has given a sum of £3,000 to the London Hospital to defray the cost of introducing the electric light. We understand that arrangements have been made to obtain a report from an electrical engineer on the cost of carrying out the work.

It is stated that Mr. J. E. Taylor, of the *Manchester Guardian*, has given £500 for the purpose of fitting the London Temperance Hospital throughout with the electric light.

At a recent meeting of the Hospital Committee of the Falkirk Town Council, the inspector was instructed to prepare a report as to the advisability of lighting the hospital by electricity.

German Patents.—Every electrician knows the strictness of the rules of the German patent law, and there is hardly an applicant out of one hundred who passes the examination without objection, opposition, or interference, under pretext that the object of the invention is not new. A correspondent, writing on the subject, says: "If, however, you look through the file of the patents granted to electrical Germans, you will be surprised to find that, if it is not all gold that glitters, it is not all new what German electricians have patented. I was not a little amused the other day when I found that one of the largest firms in Germany patented in Italy, June 30th, 1891, No. 1,151, an improvement in insoluble and porous anodes for electrical purposes, which consists in . . . . dipping the carbon anodes in boiling paraffin, to impregnate these insoluble porous anodes with a material which is not attacked by the electrolyte, *i.e.*, by paraffin. I thought this mode of protecting carbons by dipping them in paraffin was some, at least, 20 or 30 years ago."

Brighton Electric Lighting.—The agenda for yesterday's meeting of the Brighton Town Council contained statements of accounts of the Corporation Electric Lighting Undertaking for the year ended December 31st, 1892. The revenue account shows expenditure on generation of electricity, £1,643 6s. 11d.; repairs and renewals, £2 18s. 2d.; rates and taxes, £50; management expenses (including £540 14s. 6d. salaries of permanent staff), £672 9s. 2d.; special charges, insurance and commissions on installations, £89 1s.; total expenditure, £2,457 15s. 3d. A balance of £4 2s. 5d. was brought forward from last year, and the income was £4,687 4s. 2d., divided as follows: electricity sales, £4,543 4s. 2d.; meter rents, £139; and work executed for customers, £5. Of the £2,233 10s. 4d. gross profit, £2,221 6s. 1d. is transferred to net revenue account, and £12 5s. 3d. is carried forward. The expenditure in the net revenue account is £1,238 4s. 4d., interest on Brighton Corporation Stock, and £983 1s. 9d. to sinking fund; total, £2,221 6s. 1d. brought from revenue account. The balance-sheet shows liabilities £55,780 17s. 3d., divided as follows: redeemable stock, £42,031 15s. 9d.; premiums on stock issued, £2,565 11s.; floating liabilities, £11,183 10s. 6d.; The assets are machinery and plant, £15,071 7s. 8d.; electricity mains, £21,016 11s. 8d.; lands and buildings, £12,266 11s. 3d.; and smaller amounts bringing the total up to £53,172 16s. 6d.; stocks of coal and stores, £:67 7s. 4d.; uncollected revenue, £2,243 6s. 8d.; London and Westminster Bank, £1,000; total assets, £56,683 10s. 6d.; showing a surplus of assets of £902 13s. 3d.

Colchester Electric Lighting.—The Board of Trade have sanctioned the Town Council provisional order.

Hertford Electric Lighting.—The electric lighting committee recommend the appointment of an electrical engineer to advise regarding an electric lighting scheme.

Chesterfield Electric Lighting.—An expert is now to be engaged to advise regarding the electric lighting of the town.

The Institution of Electrical Engineers.—The following papers are down for reading at the ordinary general meeting on Thursday, March 23rd :—"On a New Form of Portable Photometer," by Sir David Salomons, Bart., M.A., Vice-President. "Earth Currents in India," by E. O. Walker, C.I.E., member. "Notes on the Influence of Electricity on Tanning Operations," by C. K. Falkenstein, associate.

Brighton Electric Lighting.—A Board of Trade inquiry was held at the Town Hall, Brighton, last Tuesday week, by Mr. Ingram B. Walker and Major Cardew, R.E., with reference to the application of the Brighton Electric Light Company, Limited, for a provisional order to supply electricity for public and private purposes within the borough. Mr. Fletcher Moulton, Q.C. and Mr. W. L. G. Boxall appeared for the Corporation, who opposed the application. Mr. Castle, Q.C., appeared for the electric light company.

Bolton Electric Lighting.—There are 62 applicants for the position of electrical engineer at Bolton under the Corporation, but these have been reduced to eight, as follows :—C. H. Yeaman, Liverpool ; J. H. Ryder, Halifax ; Joseph Shepherd, Leeds ; J. B. Mitchell, Bradford ; Thomas Oddy, Rochdale ; W. A. Heyes, Bolton ; H. C. Crewes, Higher Broughton, Manchester, and Thomas Barnard, Wigan. These gentlemen have been asked to attend the next meeting of the Sub-Committee having the appointment in hand.

Telephone in Lancashire.—According to the *Manchester Courier* the National Telephone Company's system in North-East Lancashire is threatened with temporary paralysis. A firm of Blackburn brewers, owning public-houses in Blackburn, Burnley, Preston, Accrington, and Darwen, over which trunk wires to Manchester, Liverpool, and other towns had been carried, have made a demand for wayleave with which the company have refused to comply. As a consequence, they have been ordered to remove the trunk wires, and also 300 wires belonging to private subscribers.

Chlorine in Electrolysed Solutions.—In all electrolytic operations of an industrial or commercial character, much profit-leakage may be saved by keeping a careful watch upon the strength and character of the solutions which are being electrolysed. For this purpose an acquaintance with volumetric chemical analysis is desirable. Many methods have been proposed for the estimation of the total chlorine, and chlorine as chloride, hypochlorite, and chlorate in electrolysed solutions ; but though they may be excellent when used in a laboratory, they are not, perhaps, so desirable when applied to commercial operations. L. M. Norton has recently been reviewing the various methods which have been proposed, and of these he regards the following mode of procedure as the most convenient. The chlorine present as hypochlorite is estimated by titration with sodium arsenite in the usual way ; then by titrating an aliquot part of the same solution with silver nitrate, and deducting the chlorine present as hypochlorite from the result, the amount of chlorine present as chloride is found. The total chlorine is estimated in a fresh portion of the solution by treating it with saturated aqueous sulphurous acid to reduce the chlorate, and then employing Volhard's well known method of adding an excess of standardised silver nitrate solution, afterwards titrating back with ammoninm thiocyanate in the presence of ferric alum. The difference between this result and the sum of the chlorine present as chloride and hypochlorite gives the amount present as chlorate.

Southend Electric Tramway.—The Town Council have resolved to raise a loan of £4,000 for providing further electrical plant and cars for the pier.

Lithanode.—A new process for the manufacture of this material in an improved form has been devised, and is being perfected by the original inventor, Mr. Desmond FitzGerald. The two patented processes hitherto published, respectively involve the use of litharge with ammonic and with plumbic sulphates—mixtures which have the disadvantage of "setting" rapidly, and yielding a product deficient in porosity. With a view to increase the latter property, crystals of various salts, to be subsequently removed by solution, have been incorporated with the mixtures ; but, by the new process, the required degree of porosity is more perfectly obtained by still simpler means. The operation of "forming" the lithanode, in which the protoxide is converted into peroxide—with a small percentage of sulphate—of lead, may now be effected in less than one-tenth of the time it previously occupied.

NEW COMPANIES REGISTERED.

American River Electric Power Supply Company, Limited (38,292).—This company was registered on the 28th ult. with a capital of £25,000 in £1 shares. To enter into, adopt, and carry into effect a certain agreement dated February 24th, 1893, made between the American River Syndicate, Limited, of the first part, Wm. Smith, the liquidator of this syndicate, of the second part, and Henry Ward, as trustee for the company, of the third part ; to carry on the business of electricians, electrical engineers, generators of, and dealers in, electrical motive power and light, and to produce, store, and accumulate electricity, electrical motive force, or similar agency. The subscribers (with one share each) are :—R. J. Jones, 6, Milford Terrace, Catford, accountant ; W. L. Bayley, Catford, accountant ; G. E. Payne, Peckham, clerk ; G. H. Wells, Dalston, accountant ; B. W. Green, East Dulwich, clerk ; F. A. Kingsbury, West Norwood, clerk ; A. R. Cox, Clapton, clerk. The number of directors is not to be less than two nor more than seven ; the following being the first : Viscount Grimston, F. Retallock, Commander O. Young, R.N., J. Taylor, C.E., and G. C. Pearson ; qualification, 10 shares ; remuneration, £300 per annum, and 5 per cent. on the surplus profits after payment of a 10 per cent. dividend on the ordinary shares. Registered by Lyne and Holman, 5 and 6, Great Winchester Street, E.C.

Electric Anti-Corrosion Company, Limited (38,309). This company was registered on the 2nd inst. with a capital of £6,000 in £10 shares, to acquire and purchase an invention for which a provisional protection has been granted, dated March 22nd, 1892, and numbered 6,105, 1892, also French patent numbered 223,664, 1892, and Italian patent numbered 472, 1892, to enter into a certain agreement made between J. Telléfsen and J. Bennett ; to acquire any suitable trade mark and to exercise and turn to account any patents acquired by the company. The subscribers (with one share each) are :—Wm. B. Gibbs, 72, Bute Docks, Cardiff, shipowner ; E. W. Pearce, Cardiff, accountant ; C. Mapy, 100, Bute Street, Cardiff, stock-broker ; A. W. Travis, Cardiff, colliery agent ; C. Ward, 54, Mount Stewart Square, Cardiff, merchant ; W. F. Bell, C.E., Merthyr Vale ; E. B. Telléfsen, 101, Leadenhall, E.C., clerk. The rules of Table "A" generally apply. Registered office, 72, Bute Street, Bute Docks, Cardiff.

Oswestry Electric Lighting and Power Company, Limited (38,303).—This company was registered on the 2nd inst., with a capital of £10,000 in £1 shares, to carry on the business of a company for the supply, at Oswestry and elsewhere, of electricity in all its branches, and in particular to supply, by electricity, light, heat and power to any person, firm, company, or corporation, municipal or local authority, and to create, accumulate and distribute electricity, magnetism, or any other similar agency. The subscribers (with

2 shares each) are:—Wm. W. Coulson, Oswestry, chartered accountant; E. M. Gardner, Oswestry, ironmonger; R. E. Hughes, Oswestry, draper; F. F. Leader, Oswestry, bank manager; A. Murshall, Oswestry, printer, &c.; J. Murshall, Oswestry, ironmonger; R. Taylor, Oswestry, station master. Registered, without articles of association, by Jordan and Sons, 120, Chancery Lane, E.C. Registered office, Oswald Road, Oswestry, Salop.

Electrolytic Separation Syndicate, Limited (38,379).—This company was registered on the 11th inst., with a capital of £25,000 in 5,000 preference and 20,000 ordinary shares of £1 each, to purchase and acquire patents, &c., conferring a right to use any inventions, and in particular the patent or other rights and privileges of Claude T. J. Vautin, for an invention for "Improvements in the method of, and apparatus for, the electrolytical separation of the bases of salts and compounds of the same from saline solutions;" to enter into a certain agreement and to carry on any business which the company may think convenient. The subscribers (with one share each) are:—R. Andrews, 153, Fenchurch Street, E.C., merchant; H. L. Ballet, 42, Old Broad Street, E.C., secretary; J. E. F. Wells, Clifton Hill, S.E., solicitor's clerk; F. Rudd, Hackney Road, N.E., clerk; F. H. Wood, Peckham, clerk; C. Vautin, 42, Old Broad Street, E.C., metallurgical chemist; A. Mosham, Stoke Newington, estate manager. The number of directors is not to be less than two nor more than seven. Qualification £100. Remuneration £100 per annum each, with £50 extra for the chairman. Registered by J. A. Maxwell, 97 and 98, Bishopsgate Street, E.C.

Electric Semaphore Signal Syndicate, Limited (38,360).—This syndicate was registered on the 9th inst. with a capital of £3,000 in £1 shares, to negotiate and make arrangements with Mr. A. J. Bailey, of "Tremere," Sylvan Road, Upper Norwood, Surrey, or other, the owners for the time being of certain British and Colonial Letters Patent, or provisional applications for such; for the manufacture of electrical signalling apparatus and the development of these patents; to manufacture all kinds of signalling utensils: to create and produce electricity, magnetism, or other similar agency; and to carry on the business of electricians, &c. The subscribers (with one share each) are: E. A. Reynolds, 82, Belvedere Road, Lambeth, engineer; W. White, 38, Nicholas Lane, E.C., Vice-Consul for Venezuela; R. Bloocam, 38, Nicholas Lane, E.C., gentleman; M. Walton, 181, Upper Thames Street, E.C., iron merchant; Wm. Bartholomew, 82, Belvedere Road, S.E., engineer; H. S. Ayres, Stamford Hill, accountant; W. H. Chantrey, Crouch End, accountant. The rules of Table "A" generally apply. Registered by Franklin, Wild & Co., 5, Broad Street Avenue, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Direct United States Cable Company, Limited.—The annual return of this company has been made up to the 10th ult., and shows that out of a capital of £1,300,000 in 65,000 shares of £20 each, 60,710 have been taken up. The total amount agreed to be considered as paid on these shares is £1,214,200.

Birmingham Telegraph Factory, Limited.—Mr. James Rhodes, of Birmingham, has been appointed liquidator of this company, which resolved, on the 13th ult., to wind up voluntarily.

Gülcher (New) Electric Light and Power Company, Limited.—The annual return of this company has been made up to the 5th of last January, and shows that out of a nominal capital of £70,000, in 20,000 ordinary and 50,000 preference shares of £1 each; all of these have been taken up, the ordinary shares being agreed to be considered as paid. The full amount has been called on 12,277 preference shares, while on the remaining 37,723 of this class, 15s. per share has been called. The amount of calls paid reaches £43,344 1s. 4d., part of which are sums paid in advance. There is £1,057 10s. yet unpaid.

Venezuela Telephone and Electrical Appliances Company, Limited.—The annual return of this company has been filed at Somerset House, and shows that out of a nominal capital of £70,000 in £1 shares, all have been taken up. The amount of calls received reaches £13,244, and that agreed to be considered as paid £56,756.

Universal Arc Lamp Syndicate, Limited.—The statutory return of this company has been filed, and shows that out of a capital of £3,000 in £1 shares, 2,865 of these have been taken up. There has been 1s. 6d. called on each share, but on 15 shares of this number subscribers have paid £1 per share. The total amount of calls received equals £228 15s.

Blakey, Emmott and Company, Limited.—At a meeting of this company held at Leeds on the 23rd ult., it was resolved to voluntarily wind up the concern. Mr. James Lakeman, of 30, St. Swithin's Lane, E.C., and Bond Street, Leeds, was appointed liquidator.

Galloways, Limited.—The annual return of this company has been made up to the 3rd inst., and shows that out of a nominal capital of £250,000 in 2,500 £100 shares, 2,108 of these have been taken up, on each of which £100 has been called. The total amount received is £210,800.

Electric Welding Company, Limited.—The annual return of this company has been filed at Somerset House, and shows that out of a nominal capital of £460,000, in 45,000 ordinary and 1,000 founders' shares of £10 each, 25,000 ordinary and 947 founders' shares have been taken up, of which 8,333 ordinary shares have been agreed to be considered as paid. An amount of £6 per share has been called upon the remaining 16,667 ordinary shares, and the full amount has been called on the founders' shares. The total sum resulting from these calls reaches £114,934, and it is estimated that £61,206 is yet unpaid.

Williamson Electrical and Engineering Company, Limited.—The annual return of this company made up to the 22nd of last December, shows that out of a nominal capital of £25,000 in 2,500 £10 shares, 500 shares have been taken up. The total amount of calls received reaches £5,000.

Epstein Electric Accumulator Company, Limited.—The annual return of this company has just been filed, and shows that out of a nominal capital of £101,000, in 1,000 founders' and 100,000 ordinary shares of £1 each, all the founders' and 70,207 ordinary shares have been taken up. There has been 5s. per share called and paid on 200 ordinary shares.

European Sims-Edison Electrical Torpedo Company, Limited.—The annual return of this company has been made up to January 5th, and shows that out of a nominal capital of £201,000, in 10,000 ordinary £20 shares and 1,000 £1 founders' shares, 7,880 ordinary and 849 founders' shares have been taken up, and 7,350 ordinary shares have been agreed to be considered as paid. The full amounts have been called on the remaining 530 ordinary shares and founders' shares, the result of which is £9,907. There is £1,542 in arrears.

Fowler, Lancaster and Company, Limited.—It was decided on January 17th last, and confirmed on February 13th, that this company should be voluntarily wound up. Mr. James Rhodes, a chartered accountant, of Birmingham, has been appointed liquidator.

British Electric Light Company, Limited.—The annual return of this company, made up to January 3rd, 1893, has been filed at Somerset House, and shows that out of a capital of £100,000 in £10 shares, 8,640 shares were taken up. There have been £11,440 agreed to be considered as paid, and the full amount has been paid on the remaining 7,496 shares, which results in a sum of £74,960.

Weybridge Electric Supply Company, Limited.—The annual return of this company, made up to January 12th last, shows that out of a nominal capital of £15,000 in 3,000 £5 shares, only seven shares have been taken up. Nothing has been called on any of these.

Hastings and Saint Leonards-on-Sea Electric Light Company, Limited.—The registered office of this company is situated at 20, South Terrace, Earl Street, Hastings.

Fowler-Waring Cables Company, Limited.—The annual return of this company has just been filed, and shows that out of a capital of £200,000 in 39,700 ordinary and 300 founders' shares, all of £5 each, 20,000 ordinary shares have been taken up, with the full amount paid on each. The result is £100,000. The 300 founders' shares have been agreed to be considered as paid.

Eastern Telegraph Company, Limited.—The annual return of this company has just been made, and shows that out of a nominal capital of £4,700,000, in 400,000 ordinary and 70,000 preference shares of £10 each, there have been 469,988 shares taken up, and the full amount has been paid, which sum reaches £4,699,880 paid.

CONTRACTS OPEN AND CLOSED.

OPEN.

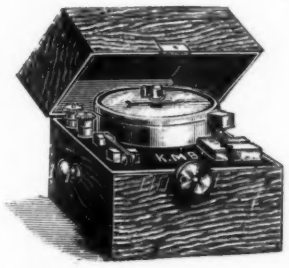
Santiago.—June 1st. The date for opening tenders for the electric lighting of Santiago has been postponed from March 1st to June 1st, 1893.

CLOSED.

Southend.—The tender of Messrs. Crompton & Co., Limited, for additional plant in connection with the Southend Pier tramway, amounting to £1,988 has been accepted by the Town Council.

BUSINESS NOTICES, &c.

"K.M.B." Portable Testing Set.—This set has been specially designed by Messrs. King, Mendham & Co., for testing insulation resistances by the direct deflection method. The galvanometer, which has a 4-inch silvered dial, is provided with a suspended needle. A series of shunts $\frac{1}{9}$th and $\frac{1}{99}$th is connected across the galvanometer and terminals are provided for the battery connections and also for the insulation of cable and earth or return. The necessary contacts for testing are made by means of a spring held midway



between two brass blocks with platinum points. One block is connected with a 10,000 ohm coil, which is for the purpose of taking the galvanometer reading with a known resistance; the remaining block is connected with the insulation terminal. It will be seen therefore that by holding this spring against one block or the other, the two required readings can be taken. By this arrangement loose plugs are avoided, and tests are quickly made. Connections are engraved on the ebonite top, and clear printed instructions are inserted inside the cover of the box.

The Henley Telegraph and Electric Construction Company, Limited.—A general meeting of the members of the abovenamed company will be held at 6, Clement's Lane, London, E.C., on April 14th, at 12 o'clock noon, for the purpose of having an account laid before them, showing the manner in which the winding up has been conducted, and the property of the company disposed of, and of hearing any explanation that may be given by the liquidator; and also of determining, by extraordinary resolution, the manner in which the books, accounts, and documents of the company, and of the liquidator thereof, shall be disposed of.

Electric Lighting of the Gardens and Forestry Exhibition.—We understand that the whole of the electric lighting arrangements for the Gardens and Forestry Exhibition at Earl's Court for the coming season have been entrusted to Mr. Guy C. Fricker, of 46, Queen Victoria Street, E.C. Mr. Fricker is also engaged in laying down a complete plant of gas engines, dynamos, and accumulators, for about 400 lamps at Messrs. Kelly's new offices and printing works, 182, High Holborn, and has recently completed the installation of nearly 200 lamps for Messrs. Colls & Sons, 2, Lime Street Square, in addition to various other smaller undertakings.

Suren, Hartman & Co. v. Henley's Telegraph Works Company, Limited.—This was an action brought for repayment of £500 paid by the plaintiffs in respect of certain shares taken by them in a company called the International Cable Company, Limited, and judgment was given upon the action by Mr. Justice Stirling in the Chancery Division on the 16th inst. His Lordship, in his judgment recited the facts in the case. He, in conclusion, declared that "the defendant company are bound to repay to the plaintiffs, either in cash or in fully paid up shares of the International Cable Company, Limited, at the option of the defendant company, the sums of £250 and £250 paid by the plaintiffs upon application for and allotment of the shares." An order was made accordingly, with costs against the defendants, to whom two months' time was allowed to repay the £500 either in cash or shares.

Charged with Stealing Electrical Apparatus.—In a case which came before Sir P. H. Edlin, Q.C., at the London County Sessions, Edwin Smith, a lad of seventeen, surrendered to bail on a charge of stealing and receiving a galvanometer, the property of his employers, the proprietors of the Woodfield Electric Works Company in the Harrow Road. Mr. Blackwell prosecuted; Mr. Slade-Butler and Mr. A. Hutton for the defence. For the defence, it was argued that the defendant had no intention of stealing the article, and the jury, taking this view of the case, returned a verdict of not guilty.

City Electric Lighting.—Messrs. Rashleigh Phipps & Co., have lately received contracts for the following installations: The Scottish Metropolitan Life Assurance Society, 8, King Street, Cheapside; Messrs. Hudson Bros' Stores, Devonshire Square, E.C.; Messrs. Kirkman & Sons', piano manufacturers, new premises, 12A, George Street, Hanover Square; The Pure Bread Company, 7, Queen Victoria Street; Mr. I. L. Langman's new house, 6, Stanhope Terrace; and Dr. F. W. Andrewe's new house, 35, Welbeck Street.

Lists, Catalogues, &c.—Messrs. Andrews & Preece, Limited, of Bradford, have sent us one of their card-lists, which is intended for fixing to the wall as a reminder of the firm's trade, address, &c.

We have received a list of patent glass bearings for plummer blocks, &c., from Messrs. Dan Rylands, Limited, of Barnsley.

Sunderland Asylum Electric Lighting.—The Town Council have accepted the tender of Messrs. Edmundsons, Limited, of Westminster, for executing works in connection with the lighting, heating, ventilating, &c., of the Borough Lunatic Asylum by means of electricity, for the sum of £4,083.

Burnley Electric Lighting.—Messrs. Kennedy & Cook, electrical engineers, have secured the contracts for the lighting of the Town Hall and the new residence of the Mayor, in Manchester Road, Burnley.

Runcorn Electric Lighting.—Messrs. A. Hall & Co. have been instructed to draw up a scheme, to make plans, and submit estimates for the complete electric light installation for Runcorn.

CITY NOTES.

Woodhouse and Rawson United, Limited.

THE following circular and notice of an extraordinary general meeting have been issued to the shareholders:—

"Woodhouse and Rawson United, Limited,
"88, Queen Victoria Street,
"London, March 9th, 1893.

"To the Shareholders,—The enclosed notice of an extraordinary general meeting is sent out in accordance with the wish of the shareholders expressed at the meeting called by the consultative committee on the 7th inst., for the purpose of enabling the constitution of the company to be modified, and to place the business of the company on a sounder basis. This modification can only be effected by reconstruction.

"It is, perhaps, necessary to point out that the resolution for winding up is merely part of the legal machinery requisite for effecting what is desired, and, in the same view, the directors do not intend to oppose the appointment of a receiver and manager on behalf of the debenture holders, as this course is taken, as they are informed and believe, in the interests of all parties, and so as to preserve the goodwill of the company as a going concern, and to involve the least possible disturbance of the business. Many of the principal shareholders have already expressed their approval of this course.

"The directors hope that you will be able to attend personally, but if you are unable to do so they will be glad if you will fill up and return the enclosed proxy.

"Yours faithfully,
"F. DEVERS SUMMERS,
"Assistant Secretary."

"Woodhouse and Rawson United, Limited,
"88, Queen Victoria Street,
"London, E.C., March 9th, 1893.

"Notice is hereby given that an extraordinary general meeting of the above company will be held at the Cannon Street Hotel, in the City of London, at 12 o'clock noon, on Monday, the 20th day of March, 1893, for the purpose of considering, and, if thought fit, of

passing as an extraordinary resolution the following resolution; that is to say:—

"'That it has been proved to the satisfaction of this meeting that the company cannot, by reason of its liabilities, continue its business, and that it is advisable to wind up the same, and accordingly that the company be wound up voluntarily, and that there be conferred on the liquidator or liquidators all the powers which, by virtue of the Companies' Acts, 1862 to 1890, can be conferred on liquidators.'

"Should the resolution be passed, a further resolution will be proposed at the same meeting for the appointment of a liquidator or liquidators, for the purposes of such winding up.

"Should these resolutions be passed, the directors propose to submit to the meeting, at all events for preliminary discussion, the scheme for the future reconstruction of the company."

There has also been sent out the report of the Investigation Committee, or Committee of Consultation, with the directors' observations opposite the various statements and comments of the committee. As the report has been already published in the REVIEW, we now give merely the directors' observations regarding same.

OBSERVATIONS.

"The directors offered from the first, and have given every facility to the Committee of Consultation for investigating the past conduct of the business, which, they presumed, would form the subject of an exhaustive report, but they urged upon the committee the desirability of an immediate preliminary report upon 'the present position and future prospects of the company,' in accordance with the resolution under which the committee were appointed.

"As shown in the prospectus, the guarantee fund was available for use in the business, and at the date of the authorisation given by the shareholders for its return was not represented by cash in hand, having been so employed. Had no arrangement been made, the whole of the £75,000 might have had to be paid in cash, which would have involved the realisation of shares and securities at great sacrifice. At the date of the repayment, the surplus profits from the first year were, in the opinion of the directors, sufficient to pay the dividend upon the second year. It was improbable, therefore, that the second and third years together would not produce sufficient profits to pay a dividend for the third year, seeing that the prospects of the company were at the time so promising.

"The profits for the first year, in the opinion of the directors, were not 'very doubtful items.' They comprised a profit of £29,000 in shares, which were all realised in cash during the three months after the date of the balance-sheet; they comprised, also, an actual cash profit of over £17,000 (not £25,000 as stated by the committee) on the formation of the Kensington Stores, which the directors were advised by counsel was properly taken as profit in the first year. Of the Okonite shares and debentures a large amount have been since realised at good prices, and although there has since been some depreciation in the shares of the Okonite Company, the debentures, amounting to £24,000, produce a safe return of 6 per cent., and are, in the judgment of the directors, worth par.

"With regard to the Jensen's Bell, the stock was bought under special circumstances much below its value, and on being valued nine months afterwards by a competent valuer, it was entered at its real commercial value. No value was assigned to the patents in the books of the company.

"With regard to the Okonite Company, at the date of the balance-sheet in September, the company had been formed and the profit was ascertained. The directors were clearly advised by counsel that they were entitled to take credit, in estimating the profits for this financial year, for profit made in connection with the Okonite Company.

"With regard to the managing director's commission, £13,775, he never received any portion of this amount in cash. He offered at the time to take for this any of the securities held by the company which the directors chose to give him, at the price they stood in the books. Shortly afterwards, however, he took £28,000 worth of shares in the company, with a view to enable the company to get a quotation on the Stock Exchange, which the shareholders were anxious to obtain, and he was credited in the books of the company with the amount of the commission, which therefore went, *pro tanto*, to pay for the shares he had taken. The net result of the transaction was that he invested the whole of the £13,775 in the company's shares, of which his present holding amounts to over £32,000. There were four other liquidators of the vendor company besides himself.

"At that time the company had acquired a large interest in the Epstein patents, which are rapidly proving of much value. The directors also anticipated reaping a large profit from the promotion of the French and Austrian Elmore Companies, and from the agreement with the British Electric Light Company.

"The value of the shares which this company held in the Phœnix Trust Company has from time to time been put at the market value of the proportion of the securities then held by the Phœnix Trust, to which this company was entitled in respect of the founders' shares held by it in that company.

"Since that valuation, Woodhouse and Rawson would have received shares and securities of the nominal value of over £12,000, the difference between this sum and the estimate of £15,000 being due to the great fall in the value of Elmore securities. The Phœnix Trust Company went into liquidation because it had divided its assets, and this company has in due course received the shares of those assets to which it was entitled.

"The company having decided, after its experience in the launching of the Okonite Company, that it would get the subscription of a sufficient capital in future cases by underwriting, the Phœnix Trust Company undertook the underwriting, and the share of the profits which it received was given in return for so doing.

"Under the existing agreement with the Epstein Company, the advance referred to is repayable, either out of net profits, or out of the proceeds of sale to any new company, or out of the issue of further shares, as these may become available. The directors are satisfied that both the advance and the shares which they hold in the Epstein Company may safely be reckoned at their full value, even if no company is formed to purchase the patents.

"The reference as to shares in the Ward Electrical Car Company. Woodhouse and Rawson United have never held any shares in the National Financial Company. [This paragraph is set against the following remark in the committee's report:—'Other items are £1,000 shares in the Phœnix Trust Company, and 1,000 £1 shares of the National Financial Company, which appears to be mixed up with the Phœnix Trust Company.']

"The manufacture of incandescent lamps here referred to was carried on under a license from the British Electric Light Company, who held a license from the Edison and Swan Company. The opinion of one of the most eminent counsel of the Chancery Bar was taken on the subject, and it was believed that the arrangements which were entered into were unassailable.

"The Phœnix Trust Company, as already explained, divided their assets, and then went into liquidation. The assets were received by this company before December 22nd.

"The shares of the company were placed in the name of the general manager as trustee. [This relates to the committee's remark that Woodhouse and Rawson United did not appear as shareholders in the register of the Phœnix Trust.]

"As is usual in the case of loans, a bonus was in some cases charged in addition to a moderate interest. Where moneys have unexpectedly come in, the company has paid off the loans to save the current interest, and thus the apparent interest at times has appeared to be large. In the case of Mr. Wood, interest was charged at 10 per cent. per annum; afterwards it was reduced to 7 per cent., and later on to 5 per cent. per annum, the interest for the first few months being taken in the shape of a bonus.

"The debt of the managing director arose, as above-mentioned, partly through his having taken preference shares of the company, and partly through his having taken at different times securities from the company at full market value, not below that shown in the balance-sheet. The agreement that payment of this debt should be taken in debenture stock was made at a date when the stock was standing at par, and the directors were of opinion that they could not subsequently depart from this arrangement, though the stock had meanwhile fallen in value.

"With regard to the valuations made by the committee, it may be mentioned, as an instance of the extreme view they have taken, that they have valued the shares and securities held by the company at only £25,000, whereas the company had £24,000 in debentures of the Okonite Company alone, which the chairman of that company has stated to be, in his judgment, an absolute security at par. In addition to this they have a large amount of debentures in other companies, to say nothing of over £60,000 of shares, amongst which are £34,000 in the Epstein Company. With the exception of the Epstein shares, no allowance has been made in the committee's estimate for any interest or dividend on any of those, although, in the case of the Okonite Company, a regular income of over £1,400 a year is received. With regard to the Epstein Company the dividend is only taken on what Mr. Epstein estimates the company is now earning, whereas he expects very largely increased returns in the immediate future.

"The holding in preference and ordinary shares of the chairman and the immediate members of his family (other than the managing director, who holds over £32,000) exceeds £6,000."

Birmingham Electric Supply Company.

THE third annual meeting of the Birmingham Electric Supply Company, Limited, was held on Thursday last week at the offices in Dale End, Birmingham, Mr. H. Buckley presiding.

The CHAIRMAN, in moving the adoption of the annual report, said that the company's experience for 1890 might be summed up as slow but steady and satisfactory progress. The number of lamps being supplied at the close of 1891 was 5,480, and at the close of 1892 the number was 8,329, the average for the whole of last year having been 6,830, as compared with 3,135 for the nine months preceding. The number of consumers increased during last year from 133 to 223, and was still increasing. It was satisfactory to note the increasing demand for the arc light, showing that consumers were fully alive to the fact that no light was more economical, not even the city gas. The company's cost of production compared favourably with that of any other company in England, but it was a matter of regret that in contracts for fittings the margin of profit was so small. Last year the profit under that head amounted to £260. In the majority of cases the company could not attempt to do work at the prices at which other contractors, under the pressure of competition, were prepared to do it. Since the last annual meeting they had issued the whole of the remaining share capital, and the company was now in the satisfactory position of having its entire share capital placed, and being entirely unfettered by preference shares or debentures, a state of affairs that was rather unusual with electric supply companies in the United Kingdom. The directors proposed to add to the depreciation reserve fund £1,279, bringing that fund to £1,636. This was considered ample for the time the company had been in existence. Before recommending the payment of a dividend, the directors thought it wise, in view of the existence on the other side of the balance-sheet of the item of £1,685, preliminary expenses, that something should be done towards creating a general reserve fund. They therefore proposed to carry £250 of the year's profits to that fund, and to declare a dividend of 3½ per cent. This dividend, he thought, would be considered satisfactory by the shareholders, con-

sidering the time the company had been at work. It was rather astonishing to him that some of their large banks and other establishments had not yet adopted the light, to the advantages of which the proprietors seemed to be fully alive. The chairman of one of the largest banks in Birmingham remarked that he did not hesitate to say that the entire cost of the change would be saved to the bank in the improved health of the staff. In reference to the proposed extension to Edgbaston and the jewellers' quarter, the company had been treated, as it always had been, with the greatest courtesy by the Corporation, but in view of the attitude of the committee to which the matter was referred, they had abandoned the intention to apply for increased powers this session. The company, however, would bring the matter forward again as soon as possible, and would press its claim upon the Corporation, unless the Corporation decided to supply those districts itself.

Mr. C. A. HARRISON, in seconding the motion, said that the shareholders had reason to be most grateful for the results which had been achieved.

The motion was carried unanimously, and the retiring directors (Messrs. G. S. Albright and Mitchell) and the auditors (Messrs. Sharp, Parsons & Co.) were unanimously re-elected.

Scarborough Electric Supply Company.

THE first statutory meeting of the shareholders of the Scarborough Electric Supply Company, Limited, was held last Friday morning at the company's offices, 102, Westborough, Scarborough. Lieut.-Colonel R. F. Steble presided.

The CHAIRMAN said that the meeting was a formal one and he did not intend to do more than explain what had been already done in connection with the formation of the company, and the construction of the works. In the first instance the Corporation had the power to bring electric light into the town, but they came to the conclusion that it would be wiser to let a private company introduce it and supply it for a term of years, as they (the Corporation) would have the power to purchase at the expiration of that time. A concession was thereupon granted to Mr. A. A. Campbell Swinton, and he set about at once to form a company to carry out the order he had obtained from the Board of Trade. He experienced no difficulty in doing so. The company was formed with a nominal capital of £50,000; and the directors then ascertained what the cost of starting the works would be. It was estimated that they would entail an expenditure of £20,000, and they determined to make an issue of shares up to £20,000. They had not the slightest difficulty in realising that sum of money; and he was now going to make a suggestion, with which, he believed, the other directors would agree, that they should increase the capital still further, not for the purpose of calling it up all at once, but in order to relieve those who had already subscribed and to enable them to extend the works without going cap in hand for the money, and paying an enormous price for it. The Chairman then went on to narrate the troubles the company had experienced in fixing upon a generating station. Eventually Mr. Peacock offered a site in Seamer Lane, and the Chairman stated the conditions under which it had been secured, and the progress of the works. They could on that site extend their works to provide 100,000 lights if necessary, and he looked with great hope on the prospects of the company.

Councillor JOHN HALL (Messrs. Hall & Tugwell) then read the report of the architects.

The Managing Director and Consulting Engineer (Mr. A. A. Campbell Swinton) also presented a report.

The retiring directors, Lieut.-Colonel STEBLE, Mr. J. W. WOODALL, J.P., and Mr. JOHN DALE, were re-elected.

On the motion of the MAYOR, seconded by Mr. D. EDWARDS, Mr. C. E. Bradley was appointed auditor at a remuneration of 15 guineas per annum.

Mr. F. BRIGHT asked if there was any period specified when the works might be completed.

The CHAIRMAN replied that he could not give a guarantee, but they expected early in July.

A vote of thanks having been passed to the Chairman the meeting terminated.

Rockhampton Gas and Coke Company, Limited.

THE directors' report to the shareholders for the half-year ended December 31st, 1892, reads thus:—"The directors again have pleasure in being in a position to place a satisfactory report before the shareholders. The half-year has been fraught with many things that will have an important bearing upon the future of the company, and the directors have endeavoured in every possible way to regulate their policy so as to preserve the best interests of the shareholders, and to extend the usefulness of the company. The commencement of the electric lighting operations was a step taken to protect the company, and to retain the power conferred upon it by the special Act of Parliament. Owing to the want of additional capital, the work of completing the private installations had to be suspended, and the electric light station has consequently been placed under the great disadvantage of running to supply merely twelve consumers. No time will be lost in finishing the various business places which are waiting for the light. As they become gradually wired up, and the full capacity of the machinery utilised, so will the revenue be sufficient for the payment of the working expenses and interest, and the directors feel sanguine of the future maintenance of the usual dividend. No definite arrangement has yet been made with the Municipal Council for the lighting of the streets with the powerful arc lamps. The company submitted a price which is now under consideration. The consumption of gas is largely increasing, and the profit in connection with this section of the company's business is therefore very good. . . . The loss sustained upon the electrical operations is £595 3s. 1d. which includes £365 14s. 5d. charged for interest upon the capital involved, together with legal expenses, printing, &c. As there are many things included in this loss, inseparable from the starting of a new undertaking such as this, the directors consider that at least a part of this should be borne by the reserve fund, and they have therefore decided to appropriate £250 of this fund towards the payment of the half-year's dividend, at the same time charging the whole loss to profit and loss account for the past half-year. Since the last half-yearly meeting a special resolution has been unanimously carried, sanctioning the creation of additional capital by the issue of 6,000 £5 shares. Of this number 3,000 are issued at a premium of 30s. per share, which will give the company a direct profit of £4,500. Applications have already been received for some of these premium shares. The shares offered to the shareholders at par are being taken up very freely, and, up to the present, applications for over 1,000 have been made. The directors recommend the payment of a dividend at the rate of 10 per cent. per annum, amounting to £1,499 16s. 5d. Contracts have been entered into at such advantageous rates to the company that a considerable saving will be effected during the year."

Direct Spanish Telegraph Company.

THE report and accounts of the directors for the half-year ended December 31st, 1892, to be presented at the general meeting of shareholders, to be held on Friday, March 24th, 1893, reads as follows:—"The accounts for the half-year ended December 31st, 1892, show, after providing for debenture interest, a balance to the credit of profit and loss of £5,438 19s. 7d. The traffic receipts show an increase of £30 14s. 7d. as compared with the corresponding period of 1891. The working expenses are £56 9s. 9d. in excess of those for the corresponding period of last year. The company's cables, and the land lines in connection with them, have continued in good working order throughout the half-year. The directors, with a view to strengthen the good relations existing between the company and their staff, propose to follow the practice adopted by many companies, in assisting their employés to make provision for their old age, or for their representatives after death. Arrangements have been made for taking out endowment policies on which, under certain conditions, the company pay one-half of the premiums. It is calculated that the amount which the company can be called upon to contribute will not exceed £250 per annum. After adding the usual sum of £2,500 to the reserve fund, the balance of profit and loss amounts to £2,938 19s. 7d. Out of this amount the directors recommend the payment of the dividend at the rate of 10 per cent. per annum on the preference shares, and a dividend at the rate of 4 per cent. per annum (free of income tax) on the ordinary shares. There will then remain a balance of £442 which will be transferred to the reserve fund in part re-payment of the balance of £1,935 9s. 4d. still remaining due to that fund for the repairs of the Falmouth-Bilbao cable in November, 1891. The reserve fund now amounts to £33,273 15s. 2d. Mr. E. Etlinger and Mr. J. Dension Pender are the directors retiring by rotation, and offer themselves for re-election. The auditor, Mr. Herbert R. Duke, retires, and offers himself for re-election."

Bath Electric Lighting Company.—The annual meeting of the shareholders of this company was held at the works last Saturday. Mr. Emile Garcke, chairman, presided. The report stated that the business of the company had steadily increased, but notwithstanding the large increase in the amount of current sold, the result shown by the profit and loss account was a loss of £300. This unsatisfactory result was ascribed to a large number of consumers still being charged on the rental system instead of by meters. The directors waived their fees for the past year. The report was adopted on the motion of the chairman, seconded by Mr. Garrett, and Mr. Butcher was re-elected auditor.

The Consolidated Telephone Construction and Maintenance Company, Limited.—An extraordinary general meeting of the members of the Consolidated Telephone Construction and Maintenance Company, Limited, is to be held at Winchester House, Old Broad Street, London, on Tuesday the 28th day of March, 1893, at 12 o'clock (noon), when the resolution reducing the capital passed at the meeting held on 9th inst., will be submitted as a special resolution.

Western Union Telegraph Company.—Dividend, 1¼ per cent. quarterly. The statement to March 31st shows: Net receipts, $1,675,000, increase, $125,000; total nominal surplus, after payment of the dividend, $6,689,818. The board have elected Mr. Thomas T. Eckert to be president in place of the late Mr. Norvin Green.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending March 12th, 1893, amounted to £359; week ending March 13th, 1892, £876; decrease £17; total receipts for half-year, 1893, £9,531 corresponding period, 1892, £8,508; increase £1,023.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending March 10th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company Limited, were £2,494.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Issue.	Name.	Stock or Share.†	Closing Quotation, March 9th.	Closing Quotation March 16th.	Business done during week ended March 16th, 1893. Highest.	Lowest.
195,100*l*	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	100 — 103	101 —104	...	...
1,247,720*l*	Anglo-American Telegraph, Limited	Stock	52 — 53	53 — 54	53⅜	52¼
2,876,140*l*	Do. do. 6 p. c. Preferred	Stock	91½ — 92½	92 — 93	93¼	91½
2,876,140*l*	Do. do. Deferred	Stock	13¼ — 13⅜	13½ — 13⅝	13⅜	13 1/16
130,000	Brazilian Submarine Telegraph, Limited	10	12 — 12½	11½ — 12¼	12⅛	12
34,600*l*	Do. do. 5 p. c. Bonds	100	100 —103	100 —103	...	...
75,000*l*	Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ...	100	105 —109	105 —109	...	...
77,978	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	3⅛ — 3⅜xd	3⅛ — 3⅜	3 5/16	3⅛
75,000	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	2⅛ — 2⅜xd	2⅛ — 2⅜	2 5/16	...
125,000*l*	Do. do. 4½ per cent. Debenture Stock	Stock	103 —105 xd	103 —105	104¼	104½
40,000	Chili Telephone, Limited, Nos. 1 to 40,000	5	3 — 4	3 — 4	...	...
630,000*l*	City and South London Railway	Stock	35 — 37	37 — 39	38½	...
40,000	City of London Elec. Lighting Co., Ltd., Ord. 40,001-80,000 ...	10	12½ — 13	12⅛ — 12⅜	12⅛	...
20,000	Do. do. 6 p. c. Cum. Pref., Nos. 1 to 20,000	10	8¼ — 8⅜	10⅛ — 10⅜	10⅜	8½
$7,716,000	Commercial Cable, Capital Stock	$100	175 — 180	175 —180	...	...
224,850	Consolidated Telephone Construction and Maintenance, Limited ...	14/-	⅛ — ⅜	⅛ — ⅜	...	...
20,000	Crompton & Co., Ltd, 7 p. c. Cum. Pref. Shares, Nos. 1 to 20,000	5	5 — 5⅛	5⅛ — 5⅜	5 7/16	5⅛
16,000	Cuba Telegraph, Limited	10	11½ — 12½xd	11½ — 12½	12 3/16	11⅞
6,000	Do. do. 10 p. c. Preference	10	17½ — 18½xd	18 — 19	18⅜	...
12,931	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	2½ — 3½	2½ — 3½	...	...
6,000	Do. do. 10 p. c. Preference	5	9 — 10	9 — 10	...	...
60,710	Direct United States Cable, Limited, 1877	20	11⅝ — 11⅞	11⅝ — 11⅞	11⅞	11⅝
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	14⅞ — 15⅛	14⅞ — 15	15	14 15/16
70,000	Do. 6 p. c. Preference	10	15½ — 16	15⅝ — 16⅛	16	15⅞
200,000*l*	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	107 —110	107 —110	...	...
1,200,000*l*	Do. 4 p. c. Mortgage Debenture Stock	Stock	113 —116	113 —116	114⅜	114½
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	15⅝ — 15⅞	15⅛ — 15⅛	15 1/16	15⅛
70,600*l*	Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	103 —106	103 —106	...	...
250,200*l*	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	103 —106	103 —106	...	...
320,000*l*	Do. 4 p. c. Debenture Stock	Stock	110 —113	111 —114	112½	112
122,400*l*	Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343	100	102 —105	102 —105	...	...
163,700*l*	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	102 —105	102 —105	...	...
300,000*l*	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	101 —104	101 —104	103	102¾
45,000	Electric Construction, Limited, Nos. 101 to 45,100	10	3½ — 4	2½ — 3	3⅜	2¾
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	... ...	... ...	...	...
100,000	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	¼ — ½	⅛ — ⅜	¼	...
82,395	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	⅜ — ⅝	⅛ — ⅜	...	...
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd.	2	¼ — ½	0 — ¼	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	1½ — 2½	1½ — 2½	...	...
180,227	Globe Telegraph and Trust, Limited	10	9⅜ — 9⅞	9⅜ — 9⅞	9⅞	9 11/16
180,042	Do. do. 6 p. c. Preference	10	15¼ — 15½	15¼ — 15½	15½	15¼
150,000	Great Northern Tel. Company of Copenhagen	10	19 — 19½	19 —19½	19 5/16	19 5/16
210,000*l*	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	104 —107xd	104 —107	...	...
12,134*l*	Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000 ...	10	4½ — 5½	4½ — 5½	...	...
9,600*l*	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	6½ — 7½	6½ — 7½	...	...
50,000	India-Rubber, Gutta Percha and Telegraph Works, Limited ..	10	22 — 23 xd	22½ — 23½	23 3/16	22⅞
200,000*l*	Do. do. 4½ p. c., Deb., 1896	100	104 —106	104 —106	...	...
17,000	Indo-European Telegraph, Limited	25	44 — 46	44 — 46	45½	...
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000	10	2½ — 3½	2½ — 3½	...	...
11,334	Do. do. Preference Nos. 5,667 to 17,000 ...	10	6 — 7	6 — 7	...	...
30,000	†Liverpool Electric Supply, £3 10s. paid	5	4¼ — 4½	4¼ — 4½	4⅜	4⅛
10,000	Do. do. fully paid	5	5⅝ — 6	5⅝ — 6	5⅞	5⅜
38,348	London Platino-Brasilian Telegraph, Limited	10	4 — 6	4 — 6	...	...
100,000*l*	Do. do. do. 6 p. c. Debentures	100	105 —108 xd	106 —109	...	...
49,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	5½ — 5⅝	6¼ — 6⅜	6 1/16	5⅞
50,000*l*	Do. 5 p.c. debentures, 1 to 5,000 in bonds of £10, £20, £40	...	102 —105	102 —105	...	...
454,747	National Telephone, Limited, Nos. 1. to 438,984	5	5⅛ — 5⅜	5⅛ — 5⅜	5⅜	5⅛
15,000	Do. 6 p. c. Cum., 1st Preference	10	14½ — 15½	14½ — 15½	15 1/16	...
15,000	Do. 6. p. c. Cum. 2nd Preference	10	13¾ — 14½	13¾ — 14¼	14¼	14⅛
90,950	Do. 5 p. c. Non-cum. 3rd Pref., Nos. 1 to 90,950 ...	5	4⅜ — 4⅝	5⅜ — 5⅝	4 1/16	4½
726,477*l*	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	113 —116	113 —116	114⅜	113½
48,800*l*	New Telephone, Limited, Nos. 25,901 to 74,700 ... (£2 paid)	10	... ...	... ...	...	...
6,318	Notting Hill Electric Lighting Company, Limited, fully paid ...	10	5½ — 6½	5½ — 6½	...	...
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	⅛ — ¼	⅛ — ¼	...	...
11,802	Reuter's Limited	8	7½ — 8½	7 — 8	...	...
18,680	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	8 — 8⅛	8¼ — 8⅜	8¼	...
20,000	Do. do. 7 per cent. pref., Nos. 20,081 to 40,080	5	8 — 8⅛	8 — 8⅛	8⅜	...
3,381	Submarine Cables Trust	Cert.	118 —123	118 —123	120½	119
78,949	Swan United Electric Light, Limited ... ... (£3½ only paid)	5	3 — 3⅛	3 — 3⅛	3	...
37,350	Telegraph Construction and Maintenance, Limited	12	35 — 38	34 — 37 xd	36½	35⅜
150,000*l*	Do do. do. 5 p. c. Bonds, red. 1894	100	101 —104	101 —104	...	...
58,000	United River Plate Telephone, Limited	5	2½ — 3	2½ — 3	2 9/16	2½
146,370*l*	Do. do. 5 p. c. Debenture Stock ...	Stock	90 — 100	90 —100	...	...
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	6½ — 7½	6½ — 7½	...	...
260,900*l*	Do. do. do. 5 p. c. Debentures	100	100 —103 xd	100 —103	102½	...
30,000	West Coast of America Telegraph, Limited	10	2½ — 3½	2½ — 3½	...	...
150,000*l*	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	105 —109	105 —109	...	...
64,242	Western and Brazilian Telegraph, Limited	15	7⅞ — 8¼	7⅞ — 8¼	8 1/16	7⅞
33,129	Do. do. do. 5 p. c. Cum. Preferred	7½	5¾ — 6¼	5¾ — 6¼	6 3/16	6 1/16
33,129	Do. do. do. 5 p. c. Deferred	7½	2 — 2½	2 — 2½	2⅜	...
184,100*l*	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	105 —108	105 —108	...	...
230,100*l*	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	105 —108	105 —108	...	...
88,321	West India and Panama Telegraph, Limited	10	1½ — 1⅝	1½ — 1⅝	1½	...
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	10⅞ — 11¼	10⅞ — 11¼	10⅝	...
4,669	Do. do do. 6 p. c. 2nd Preference ...	10	9 — 10	9 — 10	...	...
80,000*l*	Do. do. 5 per cent debentures (1917) No. 1 to 1,000	100	107 —110	107 —110	...	...
$1,336,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	120 —125	120 —125	...	...
171,000*l*	Do. do. 6 p. c. Sterling Bonds	100	101 —104 xd	101 —104	102½	102
59,900	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ...	5	5½ — 6 xd	5½ — 6	...	...

* Subject to Founders' Shares. † Quotations on Liverpool Stock Exchange. Bank rate of discount, 2½ per cent. (January 26th, 1893.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED:—Blackpool Electric Tramway Company, Limited, £10 (£6½ paid), 7½—7⅝.—Brush Company 4½ per cent. Debenture stock, issued at 1 per cent. premium, 100—103.—Electric and General Investment, shares of £5 (£1 paid), 1⅝—2⅛.—Founders' shares, 200—225.—Electric Construction Corporation, 6 per cent. Debentures, 95—98.—Electricity Supply Corporation, Ordinary of £5, 5—5½.—Elmore Foreign and Colonial Copper, Founders shares, 6¾—7½.—European Sims-Edison Torpedo Company, shares £20 (fully paid), 20—20½.—Founders' shares, 10—20.—Halifax and Bermuda Cable 4½ per cent. bonds 80—90.—House to House Company (£5 paid) 1⅜—2⅛.—Do. 7 per cent. Preference of £5, 5—5⅛.—Do. 6 per cent. Debentures of £100, 97—102.—Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid), 6—5⅛, 1st Preference Cumulative 6 per cent., £5 (fully paid), 6—6⅛.—Liverpool Electric Supply Shares of £5 (fully paid), 5¾—6.—Manchester, Edison and Swan Company, £9 (£1 paid), ⅛—¼.—Queen Anne's Mansions Lighting and Heating, Debentures, 101—103.—Woodhouse and Rawson £8 Preference (fully paid), ⅝—1⅛.

‡ Unless otherwise stated all shares are fully paid.

THE MOST ECONOMICAL AGE OF INCANDESCENT LAMPS.*

BY CARL HERING.

IT is generally supposed that it is an advantage for incandescent lamps to have a long life; the object of this paper is to show that this is a delusion, and that it is not substantiated by facts, but that on the contrary under normal conditions a very much shorter life represents an actual gain in dollars and cents; or, in more homely language, if the lamps do not die a natural death, it is more economical to break them at a comparatively early date than it is to keep them in use. The results obtained in the present deductions are so different from what is generally believed that they will doubtless be discredited by many.

¶ At the June meeting of this Institute last year a very able and valuable paper† was presented by Prof. Thomas and Messrs. Martin and Hassler on "The Life and Efficiency Test of Incandescent Lamps." This paper gives a very complete life history in the form of data and curves, of representatives of almost all the incandescent lamps made in this country. With this very complete and reliable data as a basis I have endeavoured in the present paper to deduce some figures to show what the best life of a lamp is, everything considered. It is well known that lamps deteriorate and blacken with age, becoming less efficient, and it is therefore an important question to know at what age they should be replaced by new ones; it is this point which the present paper is intended to answer.

The method by which the best age is to be deduced is the new and very rational one suggested by Mr. O'Keenan, and described in *L'Industrie Electrique*, November 25th, 1892, page 510, also in the *Electrical World*, December 24th, 1892, page 404. As it is fully described in these articles I will merely state it briefly here. Calculate *for each hour* in the life of a lamp the *total quantity of light* given off by it in candle-power hours *from the time the new lamp was first started*; similarly, calculating *for each hour* in the life of a lamp the *total cost* of this light, that is, the original cost of the lamp added to the cost of all the energy consumed by it *from the time the new lamp was first started* up to that particular hour. Now, it is evident that if for each hour in the life of a lamp we divide this total cost up to that hour by the total quantity of light up to that hour, we will obtain the *average* cost of a candle-power hour of light from the beginning up to this hour. From this final data it can readily be shown at what age this total average cost is the least. If based on actual measurements of the lamp made throughout its life, it is evident that this method will give the most rational and only strictly correct way of determining the real cost of the light actually produced, the only factor which it does not include is the interest on the cost of the lamp and power, which evidently are negligibly small. It includes the effect of the blackening of the bulb and of the lowering of the efficiency. It should be distinctly understood, however, that this method is based on the actual amount of light produced, and on the actual cost of the power; whenever, therefore, either or both of these factors are not of importance, the results deduced here are also of less importance. I desire to emphasise this, as it will doubtless be claimed by many, and with right, that the diminution of the light is of less importance to some consumers than the cost of a new lamp would be.

¶ Having given the candle-power and the power consumption of a lamp throughout its life, any one can by this method deduce the final results as described. In the present case, however, the work, which is somewhat tedious, is greatly simplified by taking the data from Table V. in Prof. Thomas's paper giving the watts per mean candle-power. This data is given here in Table I. for the seven most important of the thirteen makes of lamps; the last column giving the average is the average of all of the thirteen lamps of that paper, and not of the seven which we have here taken as the most important. By using the watts per *one* candle-power it is evident that the candle-power curve in the present calculations becomes a straight line, thus reducing the work by more than one-half.

TABLE I.

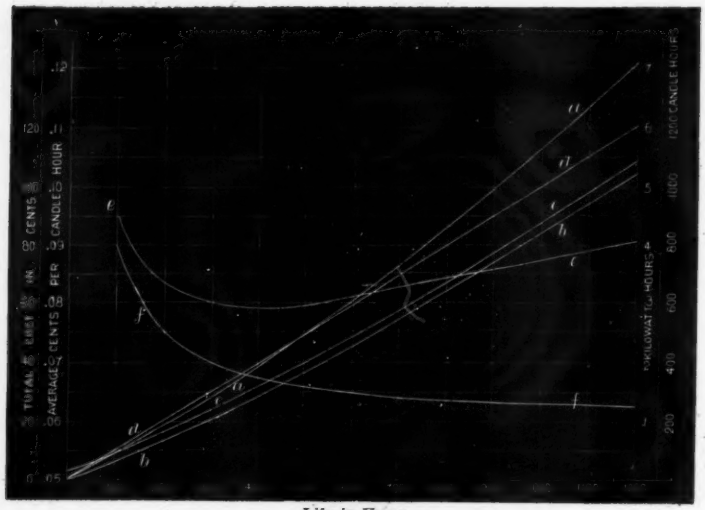
Hours.	Watts per mean horizontal candle-power.							
	A.	B.	F.	G.	K.	L.	M.	Av.
0	3·9	4·4	4·1	4·2	3·9	3·8	4·8	4·2
100	4·3	4·8	4·3	4·6	4·3	4·2	4·7	4·5
200	4·6	5·1	4·6	4·9	4·6	4·6	4·7	4·8
300	4·9	5·4	4·9	5·0	4·8	4·9	4·8	5·0
400	5·2	5·6	5·1	5·3	5·0	5·2	4·9	5·3
500	5·5	6·1	5·5	5·5	5·2	5·5	5·1	5·6
600	5·8	6·4	5·8	5·7	5·4	5·8	5·5	5·9
700	6·1	6·7	6·1	6·0	5·6	6·1	5·8	6·3
800	6·4	6·9	6·4	6·3	5·9	6·3	5·9	6·6
900	6·7	7·1	6·6	6·6	6·2	6·4	6·1	6·8
1,000	6·8	7·1	6·8	6·7	6·4	6·2	6·1	6·8
1,100	7·0	7·2	6·7	6·8	6·5	...	...	7·0
1,200	7·1	7·2	6·7	6·7	6·5	...	...	7·0

To illustrate the method let us deduce the results given for the average lamp in the last column. Instead of calculating the results for every hour, which is a very tedious process, it is sufficiently accurate to do so for every hundred hours. From the last column of Table I., calculate for each hundred hours the total kilowatt-hours consumed per candle up to that age, the result gives the curve *a*, fig. 1. Multiply these values by the cost of a kilowatt-hour of energy; 15 cents is the price assumed here; this gives curve *b*. Add to these values the original cost of the lamp *per candle*, that is, the total cost of the lamp divided by the candle-power at the start; this gives curve *c*, which is evidently parallel to curve *b*. Draw curve *d*, representing the total candle-power-hours from the start; in this case this line will evidently be straight; it would be curved if the watts consumed by the whole lamp, and if the whole candle-power had been used, instead of the watts per one candle. Curves *c* and *d* are those sought for. These curves are evidently the integrals of those represented by the numbers in the table. The process of integrating is effected most readily by purely arithmetical means as described above, that is by simply calculating the totals for each 100 hours, and it can, therefore, be performed, by any one without a knowledge of algebraic integration. These curves, however, need not be plotted; they are given here only to illustrate the method. Now divide each ordinate of the cost curve, *c*, by the corresponding ordinate of the light curve, *d*, and the result is the curve, *e*, which is the final curve sought for.

This curve, *e*, gives for each age the cost of a candle-power-hour of light, that is, *the average cost for the whole time from the time the lamp was first started up to that particular hour*. This is the curve which gives us the final results. The interesting feature about it is that it has a minimum point at about 400 hours, which means that at the end of 400 hours you are paying the least for a candle-power-hour of light, that is to say, your light is then the cheapest during the whole life of the lamp, all things considered. If you continue to use those lamps longer than 400 hours, the *average* price for the light will again increase, and will continue to do so. Strange as it may seem, therefore, it is more economical to break the lamp at that age rather than to continue running it, even though this means buying a new lamp. This result will naturally be discredited by many, but it is nevertheless true, always remembering that we are concerned with the cost of a candle-power-hour of light under normal conditions and over an indefinite period. If the amount of light is of no great importance, but the price of the lamp is, then run them until they die a natural death; the same if the power cost nothing. If your lamp costs nothing, but your power does, then replace them as often as possible. The effect of different relative costs of lamps and power will be discussed later. The data assumed in this curve is that the average lamp costs 45 cents, and the power costs 15 cents per kilowatt-hour; the latter figure was obtained from a well-known central station manager as a fair average for 110 volt continuous current circuits from central stations, or for private installations of about 500 lamps; for installations of less than 500 lamps the cost will be greater, and for more it will be less.

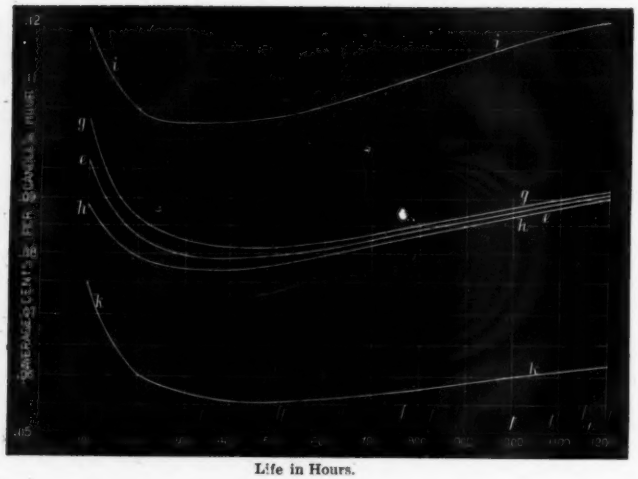
* A paper presented at the seventy-fourth meeting of the American Institute of Electrical Engineers, New York, February 21st, 1893.

† *Transactions*, Vol. ix., 1892, p. 271.



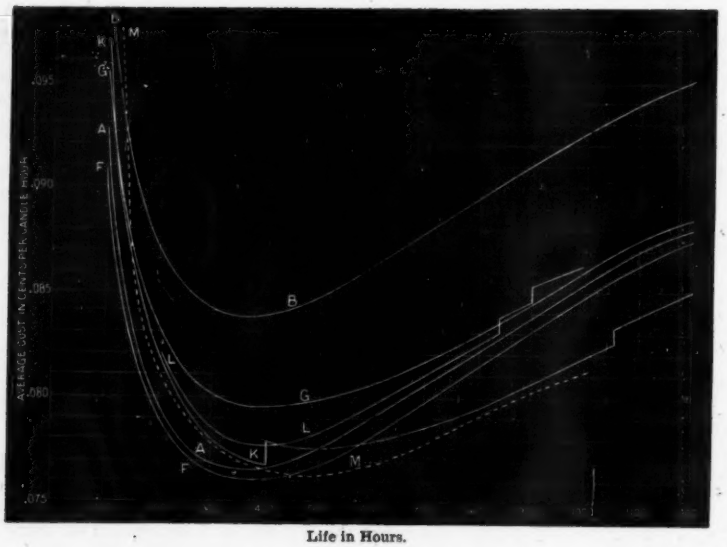
Life in Hours.

Fig. 1.



Life in Hours.

Fig 2.



Life in Hours.

Fig. 3.

As this curve must always have a minimum point for lamps which deteriorate, there is no question that there is such a minimum value in the cost of the light. Mr. O'Keenan calls this point by the appropriate name "smashing point." To show the results of an ideal lamp, curve *f* has been drawn. This ideal 16 C.P. lamp, costing 48 cents, and consuming 4 watts per candle, is supposed not to blacken or to change in any way. It is evident that in this case there will be no minimum point, and the longer such a lamp is run, the cheaper the light is, although, after a few hundred hours, the cost diminishes very slowly, being practically the cost of the power only.

To show what the curve *e* really means in dollars and cents, let us calculate an actual case. If run 1,200 hours, the average cost per candle-power is ·0903 cents, or a total of 108·4 cents per candle for 1,200 hours. A 16 C.P. lamp, therefore, represents a total cost of $17·344 for power and lamp, assuming, for the sake of simplicity, that it continues to give 16 candle-power. If stopped at 400 hours, the cost of the light is only ·0792 cents per candle-hour, or a total of 31·7 cents per candle for 400 hours; if renewed three times in the 1,200 hours, the cost will be 95·1 cents, or $15·22 for 16 C.P. This shows that replacing the lamp after every 400 hours represents an actual saving of 13·3 cents per candle during a period of 1,200 hours, or a total of $2·12 saved per 16 C.P. lamp every 1,200 hours. This amount of money represents the cost of almost five lamps at 45 c., which might be interpreted so as to show some very curious results, namely, if you bought eight lamps originally, used only three of them for 400 hours each, and threw the other five away, it will, in the long run, cost you the same as to buy one lamp and run it for 1,200 hours, assuming that you are paying for light actually received. As the cost of the light at 400 hours is over 12 per cent. less than that at 1,200 hours, it is an actual saving of 12 per cent. in dollars and cents if the lamps are replaced every 400 hours.

Another curious result, which it will be hard for many to believe, is shown by the fact that the curve *e* cuts the ·09 line at 1,200 hours, and also at about 130 hours, which shows that the light costs just as much whether the lamp is broken at 130 hours, or run for 1,200 hours. The curves being flat near their minimum points, shows that it makes practically no difference (always remembering that we are considering the cost of a candle-power hour of light) whether the lamps are replaced every 300, 400, or 500 hours. It might at first be thought that at 300 hour renewals, the lamps will make the cost greater than at 500; but this is not the case, as the curve includes the cost of these new lamps. The explanation of this is that we are considering a constant amount of light, and if run to 500 hours, more lamps must be used to give the same amount of light, owing to their reduced candle-power. Of course, in practice, they will be renewed at 500 instead of 300 hours, because the difference in the light would be noticed less than the price paid for the more frequent renewals.

Another interesting and somewhat surprising result, which may be deduced from the curves, is that an ideal lamp of 16

C.P., which remains constant, may cost originally as much as $5·75, and will then give precisely as cheap light during 1,200 hours as the existing lamps, and even then it will be cheaper during the next 1,200 hours than the others. An ideal lamp, equal to the others at 400 hours instead of 1,200, can cost as much as 75 cents, and will even then be considerably more economical after those 400 hours. This theoretical deduction only goes to show how very great the value in dollars and cents is of a lamp which remains constant.

To show the effect of the price of the lamp and the price of the power, the curves in fig. 2 have been drawn. Curve *e* is, as before, that for the average lamp costing 45 cents while the power costs 15 cents per kilowatt-hour. In curves *g* and *h* the cost of the lamp was taken at 55 and 35 cents respectively. They show that the minimum point is reached only about 50 hours later when the lamp is 10 cents dearer, and only about 50 hours earlier when it is 10 cents cheaper. The minimum cost is about 2½ per cent. more in the first case, and 2½ per cent. less in the second. The cost of the lamp, therefore, makes comparatively little difference in the best age of the lamp; it affects the cost considerably more at 400 hours than at 1,200 hours, where it is practically insignificant.

If for the same price of the lamp, namely, 45 cents, the cost of the power is taken at 20 and 10 cents, the resulting curves will be *i* and *k* respectively. This shows that the minimum point is about 100 hours earlier in the first case and 100 hours later in the second. This point is furthermore more decided when the power is more expensive (see curve *i*), showing that for expensive power it is very much more important to replace lamps earlier, while for cheaper power it will make less difference. For cheap power with cheap lamps the position of the minimum point, with respect to time, will be altered very little from that of the mean curve, *e*; this is also true for expensive lamps with expensive power. The five curves show the following:—That even for considerable ranges the best age remains at between 300 and 500 hours; that the effect of the cost of power is much more important than that of the price of the lamps; that the latter is not of so much importance as is generally believed. All the curves show that while there is a minimum point it is not very definitely located as to time; that is, it makes but very little difference if the lamps are replaced at 300, 400 or 500 hours, but after that the difference becomes apparent.

So far we have been considering the average of all the lamps in Prof. Thomas's paper. In order to show the relative differences as well as the absolute values for the different lamps, the curves in fig. 3 have been drawn for seven of the most important of the 13 lamps; they refer, though not in order, to the Thomson-Houston, Packard, Edison, Beacon, Perkins and Pennsylvania lamps. The letters of reference are the same as those in Prof. Thomas's paper. He selected these seven as the most important, and gave me the price of each lamp. These prices were divided in each case by the initial candle-power of each make, as given in that paper, to obtain the cost prices per candle. These candle-powers were as follows:—A = 16·0, B = 13·1, F = 14·2, G = 17·1, K = 17·0, L = 13·2, M = 12·5.

A comparison of these curves with those in Prof. Thomas's paper will show the effects of certain features. Such a comparison would be far more interesting and instructive were we allowed to know the names of each one of the lamps.* We can merely say here that B and G are evidently poor lamps, while M, F and A, are the best, notwithstanding that one of the M's died very early, which is equivalent to increasing the price of the other nine lamps. K would have been among the best had not one lamp broken at the critical point. The best age of all but M are between 300 and 400 hours.

The scale of ordinates in fig. 3 is much larger than that in fig. 2, and the minimum point is therefore much more marked. The offsets in curve K and L are due to breakages among the 10 lamps, of which these results are the mean. Curve M is dotted merely to distinguish it from those which it crosses at a number of places.

In addition to these curves, attention is called to those shown in *L'Industrie Electrique*, November 25th, 1892, page 510, or in the *Electrical World*, December 24th, 1892, page 404, deduced by Mr. O'Keenan for foreign lamps, in which the best age is less uniform and somewhat earlier.

* Just before going to press I have received permission from the makers to state that the lamp marked M is the "Pennsylvania" lamp. —C. H.

Whatever other deductions may be made from this investigation, the most important is that lamps might to advantage be forced much higher than is customary, at the expense of their life. This, though it requires more frequent renewals, will be a gain to the consumer as well as to the central stations; the former will get better and cheaper light, while the latter will be able to increase their output in lights or run the same number of lights at less loss in the mains, or, what is equivalent, run the same number of lamps on considerably smaller mains. How far the lamps may be forced before the other extreme is reached, is a question to be determined when we have the data for such new lamps.

In conclusion, I desire to state that while some of the results obtained from the present investigation are somewhat striking, it must not be forgotten that we have been considering the cost of *a candle-power of light*; as it is far more difficult to notice slight differences in the light than it is to notice the bills for lamp renewals, it would not be wise to adhere too strictly to what theory tells us. In practice, therefore, lamps need not be renewed as early as these deductions point out; at the same time, however, the results clearly show that it is absurd to keep lamps running too long, and that the life of our present lamps is more than sufficiently good. Perhaps the best practical rule for renewing lamps is to run them until the diminution in candle-power becomes noticeable, after that point is reached, we may rest assured that it is economical to throw them away. It might be argued that the original data is of too crude a form to admit of making deductions involving small differences. The differences, however, are not slight but very apparent, and, I presume, much greater than any possible inaccuracies in the original measurements. Furthermore, they show the existence of a uniform law. This paper should be considered more as an investigation of the subject and not as one claiming to show that present practice is radically wrong. I merely wished to prove conclusively the well-known fact, that it is absurd to run lamps too long. By far the most important conclusion is, that it would be far better to force lamps at the expense of their life than to run them at the present efficiency.

PROPER USE OF TERMS.*

By CARL HERING.

THE discussion which was started by a recent editorial in the *Electrical World* shows that notwithstanding the fact that so much has been written about the distinction between the terms power and work, and notwithstanding the simplicity of the mathematical proofs, there still appear to be some persons who cannot understand the difference, while others who do understand use the terms loosely. If greater care was taken in text-books to use and explain these terms correctly, less confusion would result. The fact that there is still some confusion in the minds of perhaps no small number, shows the importance of again bringing up this well-thrashed discussion.

Work, being simply the product of force into distance, is, of course, independent of the element of time; it may be represented by the formula:

$$\text{work} = \text{force} \times \text{distance}.$$

Power is work done in a limited time; that is, it is the rate of doing work, and therefore depends on the time in which the work is done; it is expressed by work divided by time, that is:

$$\text{Power} = \frac{\text{force} \times \text{distance}}{\text{time}} = \frac{\text{work}}{\text{time}}.$$

The essential difference between work and power, therefore, is that the former is independent of the element of time, while the latter includes the factor time as an essential element. The power of an engine, for instance, depends just as much on the time in which the foot-pounds of work are generated as it does on the foot-pounds themselves.

Simple as this may seem, however, it is nevertheless misunderstood by some persons. It is argued that a horse-power is a horse-power, whether it continues to act for a minute or a year, and that therefore the unit "horse-power" does not involve the element of time. The absurdity of such reasoning

* The *Electrical World*.

is best shown by an analogy. The speed of a railroad train is entirely independent of whether the train continues running at that speed for a minute, an hour, or a year; yet who would for a moment say that therefore speed does not involve the element of time? Power is precisely analogous to speed; it might even be defined as the speed of doing work. Speed and power are both the rates at which something is being done; speed is a distance divided by the time in which this distance has been traversed, and power is the work divided by the time in which that work has been accomplished. But both speed and power are, of course, independent of the length of time during which they continue to act.

The combination of a power with the time during which the power acts brings us to another set of convenient units, namely, the horse-power-hour, the watt-hour or kilowatt-hour. These are the products of a power and a time. We have seen that power is equal to work divided by time; therefore by multiplying power by time we obtain:

$$\text{Power} \times \text{time} = \frac{\text{work}}{\text{time}} \times \text{time} = \text{work},$$

which proves mathematically that power-hour units are true measures of quantities of work and not necessarily of power. Such units, therefore, being a true measure of work, are independent of time, notwithstanding that the word "hours" occurs in their name. The same thing may be proved mathematically by means of the absolute system, in which the dimensions of power, that is, of watts, horse-powers, &c., is $m\ l^2\ t^{-3}$, which, if multiplied by time, equals $m\ l^2\ t^{-2}$, which is the dimension of work. Horse-power hours and kilowatt-hours are therefore equivalents of units of work precisely as feet and metres are equivalents of units of length.

The expression 4 H.P., for instance, may, however, be used also to express something more than 7,920,000 foot-pounds. It may also mean 4 H.P. for 1 hour as distinguished from 1 H.P. for 4 hours or 2 H.P. for 2 hours. Whenever this distinction is meant, any careful writer will call special attention to it. However, whether this term has this additional meaning or not does not alter the fact that it is a true unit of work, even though it may embody, in a loose way, some additional qualification, which does not affect the dimension of the unit. If such a qualification is intended in the term horse-power, it certainly does not exist in the electrical terms watt-hours or kilowatt-hours. Five hundred watt-hours recorded in a meter certainly do not necessarily mean that 500 watts were used during a limited period of one hour, or that 1 watt was used for 500 hours. It means that the integration or summing up of all the individual watt-hours amounted to 500 hours; it may have been, and probably was, made up of large powers for a few hours and small powers for many hours. Moreover, 500 watt-hours are equivalent, without any qualification, to 1,127,200 foot-pounds, which does not include the element of time.

The British Board of Trade unit is the equivalent of a kilowatt-hour, but the question has arisen more than once whether it also means that 4 units, for instance, necessarily signifies 4 kilowatts for 1 hour instead of a summation of the products of various kilowatts and hours equal to 4. My own opinion is, that it embodies no such qualifications, otherwise it would not be adapted for general meter registering; I have, however, no proof at hand at this moment, but it doubtless exists somewhere.

To speak of the coal consumption, or the price of a horse-power, is evidently a loose use of the term, unless accompanied by some such term as hour or year. It has, however, become the general custom to infer the term "hour" in the former, while in the latter the figures given will show beyond question whether they refer to the cost per hour or per year; such omissions in these particular cases is, therefore, quite excusable, even though the statements are not exact.

Watt-hours (or horse-power hours) are, like heat units, direct equivalents of foot-pounds, into which they are directly convertible, without changing their dimensions. They differ only in that they are, for the sake of convenience, defined in different ways; the first is defined in terms of a power, and the latter in terms of the heat required under certain conditions. It is like defining a volt in one case in terms of ampère and ohm, and in the other in terms of the lines of force cut per second. Perhaps someone will argue that it is mathematical jugglery to say that watt-hours and heat units are measurable in foot-pounds, and offer as an analogy that resistance might be measured as a velocity, and induction as a length. But the case is different; no confusion or errors would be likely to arise from our not knowing that resistance and induction may be measured in time and length; but errors and confusion may easily, and do, arise by not remembering that watt-hours and horse-power hours are measurable in units of work, just as errors may arise by confusing the terms power and work. At all events there is no harm in knowing it, even if one does not care to make use of it.

LEGISLATION ON ELECTRICAL INDUSTRIES IN GERMANY.

In commercial matters generally the ordinary German is plodding and industrious, making sure of his ground before he proceeds far ahead. But when it comes to legislative matters he is not so particular—at least, at the present time. A few years ago, as for instance, when the Patent Bill was formulated, the members of the Government took every possible step to ascertain public opinion on the subject, and invited public discussion of the then proposed law, with the result that an Act, far superior to the English Patent Acts, was passed and came into operation. In recent years, however, a change has been noticeable in the attitude of the Imperial Government in the matter of legislative affairs. The policy now appears to be, in many cases, to hasten the passing of projected legislative measures, without consulting the wishes or suggesting the advice of experts directly concerned in the industries interested in the proposed enactments, the counsel of the State, and to some extent biassed, officials being alone accepted. The pursuance of this policy may perhaps be justified in some instances, but in cases seriously affecting different trades it is beneficial to have the advice of those directly engaged in them. The Telegraph Bill promoted some years ago, simultaneously with the Electric Light and Power Bill, was passed in haste through committee, by the Federal Council and by the Imperial Diet, and the result is that neither the Government nor business men are satisfied with the regulations of that act. The same state of affairs largely prevails in the case of the Bill regarding Electrical Installations, and which was put on one side when the Telegraph Bill was under consideration.

The Electric Light and Power Bill, the main clauses of which were published in this journal nearly two years ago, has been allowed to remain dormant in the office of a committee of the Federal Council for a year and a half, and has now been hurriedly passed through the Federal Council. With the exception of those of Government officials, the opinions and wishes of the members of the electrical industries have not been asked for, and the Bill is now about to be laid before the Imperial Diet. True it is that some of the various electrical societies in Germany have discussed the chief clauses of the Bill, but they have hitherto not taken combined action in the matter. Unity is, however, now considered to be strength, and it is partly to attain strength that the Union of German Electrotechnical Societies was recently constituted in Berlin. But the Union has been formed rather late in the day to deal in any way with the Bill, and it is to be feared that any efforts which may now be put forth in opposition to or in modification of some of the clauses of the Bill in question, will be in vain. Probably, the Berlin Society of German Engineers has dealt with the subject to a larger extent than have the whole of the electrical institutions in Germany, but even that society has only made endeavours recently, and they, too, may be too late to be of any utility. At all events, the German Electric Light and Power Bill, as already mentioned, has reached the Upper House, and any attempts which may now be made by the electrical profession to stop a Bill, which in many quarters is considered not only unnecessary but also useless, or to get modified clauses, which are regarded as likely to greatly hamper and retard the progress of electrical engineering, will now, probably, be futile. Some unkind persons assert that the Government intends in the present Bill to make up for the deficiencies of the Telegraph Act. If this is the case, the Germans may have worse before them than the provisions of the Electric Lighting Act of 1882 in England.

TENDERS WANTED FOR A CENTRAL STATION AT LIÉGE.

We give below an abstract of the specification for the erection of electricity works at Liége, Belgium:—

The Town of Liége invites tenders for the establishment of a central station for the production and sale of electrical energy, it being left to intending contractors to decide upon the installations to be erected and the system of distribution to be used. The schemes to be submitted must consider the buildings, machinery, and feeding and distributing mains in such a manner as to ensure the safety of the service, the regularity of the distributing pressure, and be capable of dealing with the progressive increase in the consumption of current. Consideration will only be given to complete schemes accompanied by plans and estimates, and each competitor must append to his tender a description and a complete and detailed estimate of all the installations. Annexed to the description, which is to furnish full particulars as to the site, buildings, motive power, reserve, &c., must be given all necessary plans drawn to a scale sufficient to allow of easy comprehension of the project submitted. These plans are to represent the site, a general plan and section of the buildings, bearing in mind an eventual increase; the arrangement of the machinery, meters, conductors, and all appliances generally found in a distributing station; details and localities of putting up the lamps, masts, or arc light standards, insulators, &c., and the methods of fixing and of insulation. Stamped tenders are to be forwarded in a registered letter to the Collège des Bourgmestre et Echevins, Liége. No one will be permitted to participate in the competition who does not append to his tender a receipt testifying to the deposit at the Caisse Communale of a provisional security of 10,000 francs (£400), but in case of one competitor sending several tenders, a single deposit will be sufficient. This sum will be returned to unsuccessful contractors immediately a decision is arrived at, whilst the successful tenderer will be required to increase his deposit to £2,000, which will form a guarantee for the carrying out of the contract. This guarantee will be refunded to the concessionaire at the termination, or, in case of forfeiture, of the undertaking, deduction being previously made of any amounts due to the town. In order to ensure the full and complete execution of the terms of the specification, the contractor must consent to a first mortgage in favour of the town to the extent of 50,000 francs (£2,000) on the site, buildings, and accessories. The contract cannot be disposed of either in part or whole without the consent of the town, and the contractor, within eight days after receiving notification of his having been awarded the concession, must pay into the Caisse Communale a sum of 5,000 francs (£200) to cover the costs of examination and adjudication.

Section 2 of the specification refers to the works and canalisations. The concession gives the exclusive right of establishing underground or overhead electric conductors for public and private supply, but an exception to this is made in the case of electric tramways which might be laid down in the town. The concession is, moreover, modified, in so far that it does not prevent the town, if desired, from utilising the public streets as it may think proper, either by the establishment of any system of distribution of motive power, electric light or other, for public municipal services, or for the use of the communal buildings, or of the commission of public ways. No excavation for the laying or repair of conductors and apparatus used in distribution can be made without previously obtaining the consent of the Collége des Bourgmestre et Echevins, and the underground cables must be laid at a minimum depth of 20 inches. In the case of overhead conductors, if the distributing pressure exceeds 300 volts, they must be sheathed, or continuously insulated. The connection between the mains and the houses will be effected by the concessionaire at the cost of the subscriber, and such expense will be calculated according to a tariff to be fixed every three years by the Collége des Bourgmestre des Echevins and the contractor. The supply of electrical energy must, at the latest, commence within a year of the notification of the approval of the contract.

With regard to public lighting, the arc lamps will be placed in the middle of the streets and public places, and they must be arranged so that a certain number of them can be extinguished after having been alight an average of four hours full lighting per day. The town guarantees annually an hourly consumption, including the lamps for the communal buildings, of 34 kilowatts during 1,460 hours of full lighting, and of 17 kilowatts during 1,740 hours. The distance of the arc lamps from the ground may vary between 7 and 10 metres.

In the case of private illumination, the minimum annual consumption of current is fixed at 8 kilowatt hours per lamp installed, and the supply must be available at any hour of the day or night. Meters will be used, and will either be rented by or sold to the consumers.

Intending contractors must state in their tenders the maximum charge at which they will undertake the production of electrical energy. The Conseil Communal will fix, and reserves the right of modifying at any time, the charges for current both to the town and to private consumers; but the rates may not be higher than 80 centimes (7½d.) per kilowatt hour, or lower than 50 centimes (4½d.) per kilowatt hour. However, for electrical energy used for other than lighting, the sale price may at any time only be 5 centimes (½d.) more than the base price to be stated in the tender. The difference between the base price tendered and the charges for current will constitute the price of the rent to be paid by the concessionaire to the town. Various fines will be imposed in case of the non-fulfilment of the clauses of the specification. The concession will be granted from the date of approval until July 16th, 1918. At that date the town will, without any indemnity, become owner of all the installations, canalisations, tools, plant, accessories, and furniture or real estate connected with the concession. The ground alone will be taken over at the price fixed in the tender. On July 16th, 1903, 1908, or 1913, the town may, by giving notice a year in advance, acquire the whole of the works, &c., at the then value. Out of the net annual profits a deduction of 6 per cent. interest on the capital invested must be made. The surplus will be divided one-third for the town and two-thirds for the concessionaire. A complete specification may be obtained on application to the Administration Communale, Liége, no date at present being settled for sending in tenders.

NEW PATENTS—1893.

4,241. "Electrical fog horn, thief detector, and alarm." A. BEZANT. Dated February 27th.

4,267. "An improvement in electroplating." T. E. WEATHERALL. Dated February 27th.

4,330. "Improvements in coupling joints for couplings of electric mains." H. W. BOWDEN. Dated February 28th.

4,356. "Improvements in or relating to welding metals electrically." W. P. THOMPSON. (Communicated by C. L. Coffin, United States.) Dated February 28th. (*Complete.*)

4,360. "Improvements in the construction of plates for accumulators or secondary batteries." W. P. THOMPSON. (Communicated by La Société Electric Phœbus, France.) Dated February 28th.

4,363. "Improvements in or connected with electric railways." W. P. THOMPSON. (Communicated by J. H. Bates, United States.) Dated February 28th. (*Complete.*)

4,368. "Improvements in electric arc lamps." B. B. WARD. Dated February 28th. (*Complete.*)

4,390. "Improvements in electric arc lamps." E. CANNEVEL. Dated February 28th.

4,416. "Improvements in dynamo-electric machines." D. FE Y FERNANDEZ. Dated February 28th.

4,425. "Improvements applicable to gas and electric lamps for automatically turning the light up and down." T. GILL. Dated March 1st.

4,489. "Improvements in and relating to electric fire alarms." E. C. C. KROGH. Dated March 1st. (*Complete.*)

4,546. "Improvements in and relating to stepped pillars or standards for carrying electric lights, wire, and the like." J. B. MILLAR. Dated March 2nd.

4,577. "Improvements in electrical distribution of energy and in apparatus therefor." R. KENNEDY. Dated March 2nd.

4,580. "An improvement in telegraphic apparatus for railways." E. TYER. Dated March 2nd.

4,685. "Improvements in recording and reproducing tapes for electrical ticker machines and other apparatus." J. E. BOTT. Dated March 3rd.

4,691. "Improvements in the manufacture and production of elements for secondary batteries." THE LITHANODE AND GENERAL ELECTRIC COMPANY, LIMITED, and J. T. NISBLETT. Dated March 3rd.

4,726. "Improvements in the electrolytic production of chlorate of potash and chlorate of soda." J. A. HEAP. Dated March 4th.

4,731. "Improvements in and relating to the measuring of electricity, and in meters therefor." R. KENNEDY. Dated March 4th.

4,734. "Electric fog signalling, and the better prevention of accidents by collision on railways." S. G. KIRK. Dated March 4th.

4,746. "Improvements in incandescent electric lamps." O. IMRAY. (Communicated by T. D. Bottom, United States.) Dated March 4th. (*Complete.*)

4,759. "Improvements in electrical resistances." W. M. MEREDITH. Dated March 4th.

4,772. "Insulating and preserving metal arms used for supporting electric telegraph insulators and for kindred purposes." T. G. MARSH. Dated March 4th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1891.

The Price of all Specifications (old and new) is now 8d. each.

9,915. "Improvements in electrical distribution by means of alternating current transformers." J. SWINBURNE and H. E. S. HOLT. Dated June 11th. When high pressure feeders with transformers at the ends are used in alternating current systems, the inventors arrange a cut-out switch in the secondary at the transformer, so as to be controlled by the primary current. On breaking the primary at the station, the secondary is then automatically broken too, an armature or core being dropped by the cessation of the primary current. 4 claims.

10,554. "Improvements in connection with the construction and working of transformers or converters." S. Z. DE FERRANTI. Dated June 20th. The inventor makes the transformer with open spaces between the primary and secondary coils and between the coils and surrounding iron. He places such a converter within a vessel containing heavy oil, so that the spaces are in an upright position in order that the oil as it becomes heated in such spaces may rise up and circulate freely through them. In connection with the oil-con-

taining vessel, he uses cooling coils or tanks through which the oil may be made to circulate either by natural flow on becoming heated or artificially by pumping or forcing appliances. 9 claims.

11,886. "Improvements in electric arc lamps." A. CANCE and SOCIETE ANONYME D'APPAREILLAGES ET D'ECLAIRAGES ELECTRIQUES, both of Paris. Dated July 13th. According to the present invention the action of gravity is utilised for effecting the approach of the carbons, the diameters and relative speed of advance of which are so calculated that the lamp shall have a fixed luminous centre. 10 claims.

12,099. "Improvements in electric motors." S. W. MAQUAY. Dated July 16th. Claims:—1. An electric motor or the like having two or more sets of magnets with an oscillating armature (or electro-magnet) between each set connected to suitable crank rods, the leads of said magnets being in connection with a commutator adjustable with respect to same, and provided with a current-carrying or collecting roller operated by the revolving shaft, substantially as described. 2. In an electric motor, or the like, a plate or disc provided with insulated rings in connection with the magnets, contact springs bearing on said ring in connection with the commutator segments, said commutator being capable of movement to alter the position of said segments, and a current-carrying or collecting roller bearing on said commutator and operated by the rotating shaft, substantially as described. 3. The improvements in electric motors, substantially as described and illustrated.

12,416. "Improvements in telephonic receivers." A. MARR. Dated July 22nd. The inventor employs two double-pole magnets and two diaphragms. The diaphragms are arranged in parallel planes between the poles of the magnets, and between them are arranged high resistance coils included in the line circuit. The cores of these coils are built up of segments, each of which is insulated from its neighbours, preferably by mica or ebonite, and they may be built upon a star-shaped centre of ebonite and be enclosed in an ebonite or other suitable insulating tube. 4 claims.

12,535. "Improvements in switches for electric installations." A. V. NEWTON. (Communicated from abroad by A. Swan, of America.) Dated July 23rd. A cam is formed with a ring of inclined projections, over which a contact piece works, it being held down in contact therewith by means of a bow spring. The cam projections, of which there are two pairs, serve to raise the contact piece above the face of a pair of contact springs, to which the electric wires are connected. The contact piece, when turned by the switch handle, will rise up the cam faces until it is well over the contact springs; the continued movement of the handle will clear it of the cam surfaces, when it will suddenly drop, by the action of the bow spring before mentioned, on to the contact springs with which the conducting wires are connected, and thus the circuit will be completed. A further movement of the handle in the same direction will pass the contact piece over, and clear of the contact springs, when it will suddenly fall, and the circuit will be broken. 2 claims.

13,114. "Improvements in or connected with electric furnaces." T. PARKER. Dated August 1st. The inventor provides at each side of the furnace a trough-like projection, and into the said trough he brings the conductors of the currents terminating them in metal blocks in the said trough, preferably at each end thereof. He then introduces into the trough carbon in a powdered or divided form, and he compresses this in the troughs, and around the terminals therein, which give a large surface of contact with the carbon. 2 claims.

13,387. "Improvements in dynamo-electric generators." J. H. CAZAL. Dated August 7th. In an inducer or field magnet, constructed according to this invention, a single wire is wound circumferentially round a bobbin to form a coil, and to each side of the bobbin is secured an iron disc, having projecting parts extending over the circumference of the coil. The projections from the two discs alternate round the circumference of the coil, and as the projections from the disc on one side are of opposite polarity to those from the other, a series of alternating poles are formed round the coil. The relative motion of the inducer or field magnets, and the armature, will generate alternating currents in the armature, which may be commutated by any suitable commutator to continuous currents. 2 claims.

13,628. "Improvements in dynamos for generating electricity." W. HARTNELL. Dated August 13th. Claims:—1. The arrangement and use in a dynamo of two annular exciting coils used for magnetising two circles of pole pieces placed opposite one another, with an armature between the said pole pieces, substantially after the manner described, whether used with an armature suited for single, two, three, or multiple phase alternating currents, or for continuous currents. 2. The system of building up dynamos with two circles of polar faces, and exciting the magnets by two coils, by which the poles may be made either "consequent," or opposite (according to the direction of the currents in the exciting coils), thus leaving to the last a choice of armature, according to the ultimate use to which the machine may be put, substantially after the manner described.

13,926. "Improvements in electric locomotives and in electric conductors for use therewith." L. B. ATKINSON, C. W. ATKINSON and F. HURD. Dated August 18th. Claims:—1 An electric locomotive in which the electro-motor is mounted elastically upon the carrying frame, and connected by chain or toothed gearing to the driving axle, the relative positions of the motor and driving axle to one another being maintained constant by links connecting the motor and carrying frames, and adapted to turn about axes which coincide with the axes of two of the rotating axles of the gearing, one being on the motor frame and the other on the carrying frame, substantially as described. 2. In such an electric locomotive the carrying frame formed in two halves, each having a pair of wheels, the two halves being jointed together and adapted to turn relatively to one another about an axis situated in a horizontal plane, and in the direction of the length of the locomotive, substantially as described. 3. The arrangement and construction of an electric locomotive, substantially as described and illustrated in the drawings. 4. In combination with a locomotive, as claimed in claim 1, a double conductor and protective board, mounted and insulated, and a connecting trolley, substantially as described.

14,063. "Improvements in telephonic transmitters." A. MARR. Dated August 20th. The inventor mounts the diaphragm of the instrument in any suitable frame or carrier, and he suspends this frame or carrier in a suitable box or casing by means of India-rubber cords or bands, or by means of spiral springs or other equivalent means, which will act as buffers to any shocks which would otherwise be transmitted from the box or casing to the diaphragm. 4 claims.

14,171. "Improvements in collectors for electric cars." G. S. GRIMSTON. Dated August 21st. Claim:—A collector for an electric car consisting of a part rigidly attached to the car, an inclined part having its end bearing against the overhead conductor, and a helical spring connecting the two parts, substantially as and for the purpose set forth.

14,859. "An improvement in incandescent electric lamps." E. A. GIMINGHAM. Dated September 2nd. Claim:—In an incandescent electric lamp, having several filaments in the one bulb, connecting the one wire of all the filaments to one contact plate or socket, and the other wires of the filaments to separate contact plates insulated from each other by non-conducting material that can be removed or can be penetrated by a powerful current, substantially as and for the purposes set forth.

14,987. "Improved electrical drill." SIEMENS BROTHERS AND CO., LTD., A. H. DYKES, and F. G. BAILY. Dated September 4th. Claim:—An electrical drill having its frame, consisting of two soft iron side bars magnetised by electrical bobbins on a cross bar connecting them, the ends of these bars adhering by attraction to an iron or steel plate to be drilled, and having on them pole segments forming field magnets for an armature which by suitable reducing gear drives a central drill spindle, substantially as described.

15,240. "An improvement in bobbins for dynamo-electric machines." SIEMENS BROTHERS & CO., LTD., and F. HIRD. Dated September 8th. Claim:—A bobbin for a dynamo-electric machine having for its core a wooden body, with a metallic piece for fixing it to the armature, attached to the wood by a strap screwed to the edge of the core, substantially as described.

15,337. "An improvement in standard electrical condensers." A. MUIRHEAD. Dated September 10th. Claims:—1. In the manufacture of standard electrical condensers the employment of two dielectrics the inductive capacities of which vary in contrary directions with temperature, substantially as and for the purpose set forth. 2. The combination in the manufacture of standard electrical condensers of plates, in which shellacked mica is the dielectric with plates of paraffined mica, as dielectric in such proportion as to reduce the variation of the capacity of the total with temperature to a minimum, substantially as set forth.

17,849. "Improvements in electric light fittings." J. A. LEA, J. F. LEA, and A. H. LEA. Dated October 19th. Consists in providing a universal joint constructed with hollow balls and central pins, of any suitable material, which give perfect freedom of action or movements, combined with firmness in construction, and secures absolute safety against abrasion or cutting of the wire or wires or cords which are passed through for conducting the current for the electric light. 2 claims.

CORRESPONDENCE.

Emile Lansard Syndicate, Limited.

The attention of my client, Mme. Claire Lansard, of 216, Goswell Road, has been called to par on p. 249 of the ELECTRICAL REVIEW of March 3rd, 1893, relating to the winding up of the Emile Lansard Syndicate, Limited.

This syndicate was established to purchase the business of M. Emile Lansard, but the purchase was never completed, and since the death of M. Lansard, such business has been carried and will for the future be carried on by my client his widow. As the statement in your paper is likely to predjudice my client's interest, I must ask you to state in your next issue by way of correction, that the paragraph does not in any way refer to the business actually carried on by M. Lansard and my client, but merely to a company which never carried on business at all.

J. H. Milton.